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Capital Needs in the Public Housing Program

Contract # C-DEN-02277 -TO001

Revised Final Report

November 24, 2010

Prepared for
U.S. Department of Housing and Urban Development
451 7th Street S.W.
Washington DC 20410

Prepared by
Meryl Finkel
Ken Lam
Christopher Blaine
R.J. de la Cruz
Donna DeMarco
Melissa Vandawalker
Michelle Woodford

Craig Torres, On-Site Insight

David Kaiser, Steven Winter Associates

Abt Associates Inc.
55 Wheeler Street
Cambridge, MA 02138

Abt Associates Inc.

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Executive Summary

This document presents an analysis of capital needs in HUD's Public Housing Program. The study builds on earlier studies of the capital needs in the public housing stock, most notably the Formula Capital Study that estimated capital needs of the public housing stock in 1998.

Measures of Capital Needs

The main goal of the study is to provide national estimates of two key measures of capital needs: existing or "backlog" needs and accrual needs.

- ***Existing Needs*** are the costs of repairs and replacements beyond ordinary maintenance required to make the housing decent and economically sustainable.
- ***Accrual Needs*** are the costs needed each year to cover expected ongoing repairs and replacements beyond ordinary maintenance assuming that all existing needs are met.

Both existing[1] and accrual needs are estimated through direct observation and inferences using the Observable Systems Approach. The approach was initially developed by Abt Associates Inc. for the 1985 HUD Modernization Needs Study and was refined by Abt Associates Inc., On-Site Insight and others for several later studies that include the 1990 Assessment of the HUD-Insured Multifamily Housing Stock, the 1995 Assessment of the HUD-Insured Multifamily Housing Stock, and the 1998 Formula Capital Study, as well as studies for individual housing authorities around the country. The Observable Systems Approach combines on-site inspection and rating of the condition of more than 300 mechanical, electrical, and architectural systems with an external costing program that provides repair or replacement costs for each system based on the observed condition. Examples of systems are roof coverings, building exterior walls, boilers, elevator shaftways, refrigerators, bathroom fixtures, landscaping, parking areas, site electrical distribution systems, and building power wiring. For each observed system a trained inspector recorded the action level required to bring the system back to original working order, a take-off measurement or count of the number of times each system is present (for example the number of elevators or windows per building or the square footage of the landscaped and parking areas), and the system's expected remaining useful life.

Inspection-based existing needs are estimated using the repair or replacement costs for each system based on observed condition, multiplied by the number of times the system is present. *Annual accrual costs* are the costs needed each year over the next twenty years to repair/replace systems that reach the end of their useful life that year, assuming that all inspection-based existing needs are addressed. In any year that a system has reached its expected life, its repair/replace cost is added into the accrual total for that year. The study presents the average accrual costs over the next twenty years.

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[1] Throughout the document "existing needs" refer to the inspection-based portion of capital needs. The terms are used interchangeably.

The inspection process excludes certain categories of costs because of the high costs of collecting data. The study did not obtain inspection-based estimates of capital needs for modifying units to comply with the Uniform Federal Accessibility Standards (UFAS), lead paint removal, or upgrades to improve energy and water efficiency. Instead, estimates for these components of costs are obtained through other means and added to the inspection-based estimates to obtain the *total estimate of capital needs*.

Study Sample

The study findings are based on inspections at a nationally representative probability sample of 548 properties in 140 housing authorities. The sample was selected from a file of public housing developments provided by HUD in early June 2008. The initial file contained 1,205,198 units in 7,404 Asset Management Projects (AMPs).

To define the sampling universe, the study team made a number of exclusions from the file.

- The study is intended to estimate the capital needs of developments likely to remain in the stock, so we removed from the file 86,896 units with proposed and approved demolition/disposition plans, completed demolitions/dispositions, or HOPE VI implementation grants that were in progress as of June 2008.
- To avoid prohibitively expensive data collection costs, the study universe excluded certain categories of properties and certain categories of capital needs. The study universe excluded the 10,596 units located in Alaska, Hawaii, Guam, and the U.S. Virgin Islands. For the same reason, the universe excluded 27,927 units in 278 developments identified in the HUD PIC system as "low density" scattered-sites (fewer than 1.5 units per building). Such developments were too expensive to inspect for the number of units they contain. Finally, as was done in the 1998 study, we also removed 218 units in 12 Turnkey developments from the study universe.

The final sampling universe included 1,079,561 units in 6,744 AMPs.

During the data collection process, we identified additional properties that were excluded from the inspection universe: units in demolished developments, units in developments no longer owned by the PHA, units in low-density scattered-site developments, units in developments undergoing modernization at the time of the inspection, and units in PHAs that refused to participate in the study. By dropping these units, the resulting inspection universe contained 980,252 units.

Following the data collection, the inspected properties were re-weighted to account for the low-density, scattered-site units, units undergoing modernization at the time of inspection, and units in PHAs that refused to participate. The resulting inspection universe is ***1,085,407*** units. As shown in Appendix A, the weighted sample represents the universe well in terms of PHA size, region, occupancy type, and development size.

Existing Capital Needs

Inspection-Based Estimates of Existing Capital Needs (See Chapter 3, Sections 1 and 2)

As the name suggests, the inspection-based estimate of existing capital needs is derived from the portion of the public housing stock included in the inspection universe and for the categories of capital needs included in the inspection protocols.

- The national average estimate of inspection-based existing capital needs is $19,029 per unit, with a median of $15,374 per unit.
- Across the 1,085,407 units in the inspection universe, the estimate of inspection-based existing capital needs is about $21 billion in 2010 dollars.
- The average per unit inspection-based estimate of existing capital needs generally is higher for larger housing authorities than for smaller PHAs. However, needs are very similar for PHAs with fewer than 250 units and those with 250 to 1,249 units. The average estimate of capital needs is $15,251 for housing authorities with fewer than 250 units, $15,572 for housing authorities with 250 to 1249 units, $17,774 for housing authorities with 1,250 to 6,600 units, and $28,553 in housing authorities with more than 6,600 units (excluding New York, Chicago and Puerto Rico).
- The estimates of inspection-based existing capital needs per unit in Chicago and Puerto Rico are lower than the estimates for other very large PHAs: $12,359 in Chicago and $15,610 in Puerto Rico. This results in part from extensive modernization programs at these housing authorities in recent years. The needs in NYC were similar to other very large PHAs, averaging $30,042 per unit.
- As expected, the estimate of existing capital need is substantially higher for family developments than for elderly developments, $22,190 versus $11,646.
- The 25th and 75th percentiles show the broad range of existing capital needs. Nationwide, one quarter of units have needs of under $5,248 per unit, and one quarter have needs greater than $28,570.
- Inspection-based needs are highest for units in the West, averaging $39,221 per unit, and lowest in the Midwest, averaging only $9,507 per unit. The reasons for high costs in the West may be related to the age of properties in that region. Properties in the West often are newer than in other places, and many have not gone through an initial round of modernization yet. Thus the average age of the systems inspected is older than in other regions. In addition, 70 percent of properties in the West are rowhouse/townhouse properties, which have higher costs per unit than other property types. Only 45 percent of properties nationwide are rowhouse/townhouse types. Finally, fewer properties in the West have been awarded HOPE VI awards, leaving some of the higher needs properties without that source of funding. The lower needs estimate in the Midwest is driven in part by the distribution of occupancy type. More than half of all units in the Midwest are in developments for elderly residents, compared with 30 percent nationwide. Generally units for the elderly have lower per-unit repair needs than units for families.

- The key cost drivers for existing capital needs are windows, kitchens, and bathrooms. These three systems combined account for nearly 40 percent of all existing capital needs. Windows alone account for about 15 percent of need. While windows are the largest component of costs, windows need repair or replacement in only about 37 percent of properties. About 80 percent of properties require some action for the two second highest cost drivers, kitchens and bathrooms.

Total Capital Needs (See Chapter 3, Section 3)

The inspection-based estimates do not include all categories of units or all categories of capital needs. The estimate of total capital needs consists of the inspection-based estimates plus estimates that account for the categories of need and categories of properties not included in the inspections. Exhibit ES-1 shows the estimate of total capital needs and its components. The methodologies for estimating categories of need that are not based on inspections are not as robust as the methodology for the inspection-based estimates, and they should be viewed with some caution.

Exhibit ES-1

Category of Need	Estimate
Inspection-based estimate of need	$20,653,780,000
Additions for Alaska, Hawaii, Guam, and USVI	$233,514,000
Additions for lead paint abatement	$306,788,000
Additions for accommodating persons with disabilities	$264,473,000
Additions for improving energy and water efficiency	$4,149,439,000
TOTAL	**$25,607,994,000**

- ***Estimates for Alaska, Hawaii, Guam, and the U.S. Virgin Islands:*** The total estimate of existing capital needs for the 10,596 units in these PHAs is $233,514,000, which relies on the national average inspection-based need per unit, multiplied by local cost adjustments for each location.
- ***Estimates for lead paint abatement:*** The estimated cost associated with removing any remaining lead from the public housing stock is based on responses to a survey of PHAs conducted for this study. Responses to the PHA survey indicate that currently about 5.8 percent of the stock (62,000 units) needs abatement, and the average cost of recent removal has been about $5,000 per unit. Thus, the total national cost of lead abatement is $306,788,000.
- ***Estimates for accommodating persons with disabilities:*** The source of our estimate of the cost associated with complying with Uniform Federal Accessibility Standards (UFAS) was also the PHA survey. The PHA survey indicates that currently about half of PHAs have made at least five percent of their units accessible, and the other half needs to make about two percent of their units accessible, so only about one percent of the public housing stock needs to be modified, or 10,684 units. The average cost reported by PHAs was about $25,000 per unit, for a total national cost of $264,473,000.

- ***Estimates for improving energy and water efficiency:*** In order to provide an estimate of the modernization costs needed to improve energy and water efficiency, our subcontractor Steven Winter Associates developed a capital cost calculator to model the appropriate improvements to make for each sample development. The cost calculator takes into account development characteristics such as energy usage, fuel types, lighting types, ages of particular systems (windows, appliances, etc.), and development location, along with national estimates for possible savings associated with various improvements. Capital costs for moderate energy and water efficiency improvements with less than a 12 year payback are $4,149,439,000.
- The sum of these national estimates for omitted locations, lead paint abatement, accessibility, and energy and water efficiency was added to the total inspection-based estimates of existing needs to reach on estimate of total capital needs of $25,607,994,000 or $23,365 per unit.

Average Annual Accrual of Capital Needs (See Chapter 3)

The estimates of annual accrual of capital needs assume that all existing needs are addressed right away. Key findings regarding accruals are:

- Across the inspection universe of PHAs and properties and assuming that existing capital needs were completely addressed, each year approximately $3.4 billion would be required to address the ongoing accrual needs, or on average $3,155 per unit.
- Accrual costs, in an absolute sense, do not vary substantially across properties. The 25th percentile across all properties is $2,443 per unit; the 75th percentile is $3,790.
- Average annual accrual needs per unit are higher in smaller-size agencies than in the larger ones. This could be due to a combination of factors. Many of the smaller agencies have newer housing stocks. On average, these properties are in better condition than those in larger agencies, as indicated by their lower level of average existing needs. Since fewer items need immediate replacement, upcoming needs are higher. Moreover, smaller PHAs have a higher proportion of walk-up and rowhouse buildings in their stocks, which tend to have fewer units per building. As a result, the accrual costs for these properties on a per unit basis are higher than in larger agencies.
- As with existing needs, the key cost drivers for accrual needs are windows, kitchens, and bathrooms. Kitchens contribute the most to accrual needs. Kitchens are present in every unit, and appliances, floors, and cabinets have relatively short useful lives, particularly in family developments. (See Chapter 3, Section 2)

Total Capital Needs Over the Next 20 years

In order to assess the total capital needs for the public housing stock over the next 20 years, we can combine the inspection-based estimates of existing needs with the accrual estimates for years 1-20. This yields a total estimate of capital needs for the next 20 years of approximately $89 billion for the inspection universe, or $82,125 on a per unit basis.

Changes in Capital Needs from 1998 to 2010 (See Chapter 4)

One goal of the study is to estimate the changes in capital needs between 1998 and 2010 and to explain any reasons for the differences.

- A simple comparison of 1998 and 2010 figures shows that the estimated total backlog of capital need decreased from about $36 billion in 1998 (expressed in 2010 dollars) to about $26 billion in 2010. Part of this decrease reflects the fact that there were 9 percent fewer units in 2010, but the average backlog amount per units also decreased, from just over $30,000 per unit to less than $24,000 per unit, a drop of about 21 percent. If all that had happened was a decrease in the number of units, total capital need in 2010 would be about $32.5 billion.

  Annual accrual needs increased from $2,466 per unit in 1998 (expressed in 2010 dollars) to $3,155 per unit, an increase of 28 percent. The rise in accrual costs is related to the decrease in existing backlog. Since fewer items are being repaired immediately, they need earlier replacement in the future.

- The change in the estimate is largely a function of a number of improvements in the methodology used to estimate existing capital needs and of some underlying assumptions, particularly regarding the inflation factor used to adjust the 1998 numbers. The most significant change was in the methodology for treating over-age systems. In 1998 we assumed that all over-age systems would be repaired or replaced as part of meeting existing needs. The approach used in the current study allows for some over-age systems to remain in place if they are still in working condition. It is assumed that they will be replaced at a later date—at their expected failure time. Inspectors used their judgment and experience to assign a remaining useful life to all observed systems that could be longer or shorter than the expected useful life from standard tables.

  If the 2010 estimates were carried out using the same approach to treating over-age systems as in 1998, the estimate of inspection-based existing needs in 2010 would be $32 billion (instead of $21 billion) and the per unit estimate would be $29,421 instead of $19,029. Under these assumptions, the total estimate of inspection-based capital needs decreased by 3 percent over the period, resulting from the 9 percent decrease in the stock and a 6 percent increase in the needs per unit.

  Similarly, assuming that all over-age systems are replaced as part of addressing the backlog, the average annual accrual numbers would be smaller, $2,829 per unit instead of $3,155.

  In order to compare the 1998 estimate with the 2010 estimate, we inflated all 1998 dollars by 34 percent, which is the percentage increase in the CPI over the period. However, it is not clear that repair costs have risen at the same rate as the overall CPI. For example, in contrast to the CPI, the RSMeans construction cost index rose by 59 percent. If we inflate 1998 costs by 59 percent instead of 34 percent, the estimate of inspection-based existing needs for 1998 would be $39 billion (in 2010 dollars) instead of $33 billion (assuming a 34 percent inflation factor) The resulting higher value for 1998 would indicate a greater reduction in the backlog. (See Chapter 4, Section 2).

Chapter One. Introduction

1.1. Overview

This congressionally mandated study of public housing capital needs builds on earlier studies of capital needs in the public housing stock, most notably the Formula Capital Study that estimated capital needs of the public housing stock in 1998.[2]

The main goal of the study is to provide national estimates of two key measures of capital needs: existing or "backlog" needs and accrual needs.

- ***Existing Needs*** are the costs of repairs and replacements beyond ordinary maintenance required to make the housing decent and economically sustainable.
- ***Accrual Needs*** are the costs needed each year to cover expected ongoing repairs and replacements beyond ordinary maintenance.

Both existing and accrual needs are estimated through direct observation and inferences using the Observable Systems Approach developed by Abt Associates Inc. The approach was initially developed by Abt Associates Inc. for the 1985 HUD Modernization Needs Study and was refined by Abt Associates Inc., On-Site Insight, and others for several later studies that include the 1990 Assessment of the HUD-Insured Multifamily Housing Stock, the 1995 Assessment of the HUD-Insured Multifamily Housing Stock, and the 1998 Formula Capital Study, as well as studies for individual housing authorities around the country.[3] The Observable Systems Approach combines on-site inspection and rating of the condition with a computerized costing system based on a consistent set of repair/replacement costs that are adjusted for regional price differences to develop stock-wide assessments of need.

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2 In the conference report 110-443 accompanying HR3074 (enacted in late December 2007), the Transportation, Treasury, Housing and Urban Development, the Judiciary and Independent Agencies Appropriations Act, 2008, the conferees stated that they directed: "HUD to perform an updated Capital Needs Assessment (CNA) from funds made available under this account for the public housing portfolio, including the projected annual cost to adequately maintain that portfolio. To conduct the new CNA, HUD shall contract with a nationally recognized research entity with experience in conducting physical needs assessments of a representative sample of public housing or similar development projects. The review shall include a statistical sample for projects of 500 units or less and one-for-one review for projects in excess of 500 units…."

3 Dixon Bain et al., Study of the Modernization Needs of the Public and Indian Housing Stock (Cambridge, MA: Abt Associates Inc., March 1988); James Wallace et al., Current Status of HUD-Insured (or Held) Multifamily Rental Housing (HUD, PD&R 1993). Judie Feins et al., Viability Review for Physical Improvements for the San Francisco Housing Authority (Cambridge, MA: Abt Associates Inc., Sept 1991); Meryl Finkel et al., Status of HUD-Insured (or Held) Multifamily Rental Housing in 1995 (Cambridge, MA: Abt Associates Inc., December 1998); Meryl Finkel et al., Capital Needs of the Public Housing Stock in 1998 Formula Capital Study, Abt Associates Inc., March 2000.

As was the case in the 1998 study, a number of components of capital needs have not been measured directly through inspections, but instead have been externally generated and added on to the inspection-based estimates to provide total national existing and accrual needs.

In addition to developing estimates of the existing capital needs and accrual needs, the study has a number of other research goals:

1. Generate reliable estimates of the change in needs from 1998 to present—for the national sample and for major subcategories of public housing authorities (PHAs) and explain the differences. Differences could reflect changes in the public housing stock, differences in methodology between the two studies, or changes in the real, inflation-adjusted costs of making repairs and replacements;
2. Assess whether the current REAC inspection system can provide useful estimates of capital need;
3. Describe the way in which PHAs are now estimating existing capital needs; and
4. Assess the impact of conversion to asset-based management, including consolidation of developments into asset management projects (AMPs), on estimating modernization needs.

The report is organized as follows. The remaining portion of this chapter provides an overview of the data sources and sampling approach. Chapter 2 describes in detail the "Observable Systems" methodology we used for inspecting units and describes how we converted the inspection data into measures of the costs of existing capital needs and accrual. Chapter 3 presents our estimates of existing needs and accrual for the nation as a whole and for certain categories of PHAs and properties, based on the inspectors' observations. The chapter also provides estimates of the cost of total existing and accrual needs by adding estimates for the public housing units and the categories of need that were not included in the inspections. We compare 2010 capital needs with 1998 capital needs in Chapter 4 and discuss the reasons for differences between the two estimates. Chapter 5 addresses the study's other research questions regarding the ability to use REAC inspections to estimate capital needs, the methods PHAs currently use to assess needs, and the impact of the transition to asset management on capital needs. The report includes five appendices that address sampling, data collection, costing methodology, the capital cost calculator for energy- and water-efficiency improvements, and details on the REAC inspection process for some of the systems that are key cost drivers of existing needs.

1.2. Data Sources

This study relies on a number of primary and secondary data sources. Primary data collection efforts include on-site inspections, development of a cost file, and a survey of PHAs. Other data include HUD administrative data from the PIH Information Center (PIC) that were used to define the public housing universe, draw the sample of properties for the study, and perform other analyses.

Primary Data

This study includes three primary data collection efforts:

- collecting on-site physical inspection data;
- developing a file of repair costs; and
- conducting a survey of the PHAs at which physical inspection data were collected.

Inspection Data. By far the largest data collection effort was the on-site physical inspections. We collected data on a sample of 548 properties[4] in a nationally representative sample of 140 PHAs across the country. Within each sampled property, we collected condition and measurement information on over 300 items at approximately 4 buildings and 4 units per property.

Cost File. In order to use the data on conditions observed during the physical inspections to estimate capital needs, we developed a cost file that provides a repair cost estimate for each system based on its condition, materials, and quantity. As in the other recent studies of capital needs, the cost estimation firm of A.M. Fogarty and Associates assisted in developing the cost file based on prevailing construction material and labor cost indices.

PHA Survey. As part of the primary data collection effort, we conducted a survey of the sampled PHAs. The goal was to complete the survey for all 140 PHAs sampled for physical inspections, but only 116 PHAs responded (83 percent response rate). The response rate for particular questions was often lower. Through the survey, we (1) obtained information on each PHA’s own estimate of capital needs and anticipated expenditures over the next five years for the sample properties, (2) obtained actual costs and expenditures related to these items over the previous five years, (3) collected general information about the PHA, including its strategy for addressing capital needs, its strategy for making rehabilitation economically sustainable, its methods for estimating capital needs, recent and pending changes to the PHA’s public housing stock, and the PHA's progress towards asset management, and (4) collected documents from the PHA including any recent Physical Needs Assessments (PNAs) conducted on the sample properties. As described in Section 3.4 below, the PHA survey was the primary source of information regarding the need for, and costs of abating lead

4 As described in Section 1.3 and Appendix A, for this study we are defining “properties” as the development components according to the pre-asset management reform definition that make up each new AMP. For this document and throughout the study we will use three terms to reflect three concepts. *Development* is defined as it was in the pre-asset management reform world. *Asset Management Project (AMP)* is the grouping of units and buildings that form a new “development.” In many cases old developments have been merged into a single AMP, and in some cases developments have been split into a number of AMPs. *Property* is the component of an old development that moved into a new AMP. For a single development that moved into a single new AMP the development, property and AMP are all the same. For an AMP that is comprised of a number of old developments, the properties in the new AMP are the old developments. In cases where old developments were split into a number of AMPs, the property is the portion of the old development that moved into the AMP. In this report, we use "property" and "development" interchangeably to refer to the entities used for sampling and described by analysis.

paint and modifying units to comply with the Uniform Federal Accessibility Standards (UFAS). Due to the limitations of the PHA survey, these estimates should be viewed with caution.

Secondary Data

Data for Universe Definition and Sampling. Several HUD data files were used to define the current universe of public housing properties and to compare them to the universe of properties included in the study conducted in 1998.

To define the universe of public housing properties for this study, we used a file supplied by HUD in early June 2008 showing developments grouped together as Asset Management Projects (AMPs) under the new asset management system. The file was derived from HUD's PIC system and included records at the building level. It mapped out the components of the traditionally defined public housing developments (by development number and unit count) that make up each of the AMP groupings. In addition, the file identified units that were scheduled for demolition/disposition and those with approved HOPE VI implementation grants.

To identify scattered-site developments and those developed under particular public housing program types (HOPE VI, mixed-finance, turnkey), we used another data extract of the PIC system provided by HUD staff.

1.3. Study Sample[5]

Sampling Approach

The congressional language mandating the study required a nationally representative sample that included all developments with more than 500 units. To achieve this goal, we selected 140 housing authorities. Within each selected housing authority, a sample of properties was to be selected, with a total target of 550 properties.

The sample was selected from the 2008 file we obtained from HUD, which contained 1,205,198 units in 7,404 AMPs. To define the study universe, the study team made a number of exclusions from the file.

- Because the study is intended to estimate the capital needs of developments likely to remain in the stock, we removed from the file 86,896 units that were identified as having proposed and approved demolition/disposition plans, completed demolitions/dispositions, or approved HOPE VI implementation grants as of June 2008. We did not remove completed HOPE VI developments from the sampling universe.
- To eliminate prohibitively expensive data collection costs, the study universe includes only developments located in the contiguous 48 states, the District of Columbia, and Puerto Rico. Excluded were 10,596 units in Alaska, Hawaii, Guam, and the U.S. Virgin Islands.

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5 Further details on the sampling are included in Appendix A.

- For the same reason, the study team decided to exclude 27,927 units in 278 developments identified in the HUD PIC system as "low density" scattered-sites (fewer than 1.5 units per building). Such developments would be expensive to inspect for the number of units they contain.
- Finally, as was done in the 1998 study, we also removed 218 units in 12 Turnkey developments from the study universe.

The final sampling universe included 1,079,561 units in 6,744 AMPs.

The HUD file contained 164 completed HOPE VI developments (12,524 units) and 206 mixed-finance developments (11,378 units). Given their small number, the probability of selecting these developments and units in the inspection sample would be low. By chance, no such developments were in the final study sample.

Selecting PHAs and Developments

PHAs and developments were selected using a multiple-stage probability sample based on probability-proportional-to-size (PPS) sampling, where size is indicated by the number of public housing units in the housing authority (for selecting PHAs), and by number of units in the development (for selecting developments).

The sample consisted of a base sample of 140 housing authorities and a replacement sample of 5 housing authorities. The replacement sample was intended to be used if housing authorities turned out not to be eligible for the study (based on their public housing stock) or if they refused to participate in the study. We pursued all 145 housing authorities. Our final study sample included 140 PHAs, as planned. Two of the initial 145 PHAs refused to participate, and three had only ineligible properties.

Housing authorities were selected with probability proportion to size (PPS) in multiple stages. There were a total of 2,046 housing authorities in the sampling universe. In the first stage, we identified all the housing developments with 500+ units and selected them with certainty. There were a total of 162 such developments, spread across 27 housing authorities. These housing authorities were thus selected with certainty, because they had developments selected with certainty.

To select the remaining housing authorities, we defined a new sampling universe for the second stage selection by removing the 162 developments already selected with certainty. The remaining housing authorities were then selected with PPS based on the new sampling universe. However, because some of the large housing authorities would have been selected in this stage because of their size and they would inevitably overlap with the 27 certainty authorities already selected, the target number of selected housing authorities for this stage could not be determined *a priori*. Rather, it was determined by an iterative approach. After a series of trials, we found that a sample of 135 housing authorities at the second stage would yield an overall sample of 145 housing authorities, including the 27 housing authorities selected in the first stage.

In order to ensure representativeness along dimensions of interest to HUD, selection of the non-certainty housing authorities at the second stage was done using 18 sampling strata: 4 Census regions

(Northeast, Midwest, South, and West), 4 housing authority size categories (<250 units, 250 to 1,249 units, 1,250 to 6,600 units, and over 6,600 units), New York City Housing Authority, and Puerto Rico Housing Authority.

The second stage sample is of *properties*, defined as the development components (according to the pre-asset management reform definition) that make up each AMP. We used the pre-AMP definition of property both to keep down the logistical costs of the inspections and to make it easier to compare the study results to the results of the 1998 study.

Properties were selected in a multi-stage framework. All 162 properties with 500+ units had already been selected with certainty. To select the remaining developments, we first removed the 162 certainty properties from the sampling universe. Next, we further restricted the sample to the 135 housing authorities identified at the second stage of the housing authority selection. Properties for each housing authority were sorted by AMP, and within each AMP by property. To account for properties unable to participate in the study, the study team determined that a sample of 404 properties was required, which would yield a sufficient number of replacement properties. This implied that we would need to pick on average 3 properties from each of the 135 housing authorities. Given that some of the small housing authorities have fewer than 3 properties, other housing authorities in the list were over-sampled to ensure that we obtained a sample of 404 distinct properties. The properties were selected with probability proportional to size.

To summarize, the initial list of sampled properties contains 162 certainty properties and 404 non-certainty properties, arriving at a total of 566. This allowed for a replacement sample of 16 properties. As described in detail in Appendix A, inspections were actually completed in 548 properties. The list of selected PHAs and developments, and those where inspections were actually completed are shown in Exhibits A-4 and A-5 in Appendix A.

Chapter Two. Methodology for Estimating Capital Needs and Costs

On-site inspections of physical condition and detailed data on the costs of repairs and replacements were used to estimate capital needs at a sample of 548 public housing properties. These estimates were then used to create national estimates of capital need and estimates for particular categories of PHAs and properties. The methodology for conducting inspections and deriving cost estimates is described in this chapter.

2.1. Observing Needs through Inspections

Capital needs were estimated using the Observable Systems Approach developed by Abt Associates Inc. The Observable Systems Approach is based on on-site inspections and ratings of the property's physical condition. The term “observable systems” indicates that the physical condition of the system is capable of being observed and assessed in the field, and that “destructive” testing is not involved (e.g., opening up a wall to check for insulation or broken pipes). In certain instances, the observation is a judgment, based on knowledge of conditions of such systems, modified by whatever data (either inferred or provided) are available at the site.

The Observable Systems Approach was initially developed by Abt Associates Inc. for the 1985 Modernization Needs Study.[6] The methodology was further refined for several later studies, including the 1990-1992 Assessment of the HUD-Insured Multifamily Housing Stock, an assessment of the capital needs of the San Francisco Housing Authority, the 1995-1996 Assessment of the HUD-Insured Multifamily Stock, and the 1998 assessment of the capital needs of the public housing stock (Formula Capital Study). It has further been refined by On-Site Insight (OSI) in their work for local public housing agencies conducting capital needs assessments and handicap accessibility assessments.

For each sampled property, inspectors gathered two kinds of information:

1. Current conditions—which were used to identify the actions required to bring all systems up to their original condition; and
2. Property take-offs—measurements of average unit sizes, typical building dimensions, and other aspects of certain systems. The take-offs were used both to determine the costs of meeting current needs and to estimate accrual costs.

For this study, we used On-Site Insight’s current forms and inspection protocol as our starting point and made modifications.

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6 Dixon Bain et al., *Study of the Modernization Needs of the Public and Indian Housing Stock* (Cambridge, MA: Abt Associates, Inc., March 1988).

The inspection protocol requires observing the conditions of more than 300 mechanical, electrical, and architectural systems. A "system" is defined as a quantifiable component of the site, building exterior, mechanical and electrical devices, building interior, or specialty item. Examples are roof coverings, building exterior walls, boilers, elevator shaftways, refrigerators, bathroom fixtures, landscaping, parking areas, site electrical distribution systems, and building power wiring.

The systems observed on On-Site Insight's current forms and protocols are largely consistent with the systems observed in the 1998 public housing capital needs study. The primary difference between On-Site Insight's current protocols and those used in 1998 are the additional "types" of systems captured. For example, in 1998 we had three types of fencing—chain link, wrought iron, and wood stock, and did not collect the height of the fence. On-Site Insight's current forms capture five types of fencing: chain link, wrought iron, stockade, privacy screen/basket weave, and rail wood, and they collect the height of the fence in three different size categories.

For each system, the inspector evaluated and recorded the action level needed to restore the system to its original condition. The term "action level" refers to the level or nature of the repair required to restore the system to its original condition. For each observable system, the inspector chose among five action levels, each of which corresponds to a specific set of repairs for that system. The action levels are:

- No action required;
- Minor action required;
- Moderate action required;
- Major action required; and
- Replacement required.

Each action level is precisely defined for the system in question, so that assessments can be objective and consistent across inspectors. For example, for bathroom fixtures, the "minor" action is to replace the sink; the "moderate" action is to replace the toilet. The "major" action is replacing both the sink and toilet or replacing the tub. The "replace" action involves replacing all components (tub, sink and toilet).

For this study, we estimated capital needs in a way that combines repairs, replacements, and upgrades when appropriate. If the number of system components that require significant repair or replacement was above a certain threshold, the inspector recorded that the entire system needs upgrading, versus repairing the specific components. For example, if three or more kitchen components required significant repairs or replacement, the inspector noted that the entire kitchen requires upgrading. See Appendix C for a detailed description of the upgrade algorithm. In the 1998 study, the inspectors determined that a system required upgrading based on whether upgrades were needed "for a moderate market conversion," (whereas the repairs and replacements were at a relative lower quality level in terms of construction material). For this study we assume that all repairs, replacements, and upgrades are made at the "moderate" quality in terms of construction material.

During the inspections, the inspectors obtained information on the current age of each system by observation or from the property manager/escort. The inspectors were also instructed to use their professional judgment to determine and report the remaining life of each system. If a system was still in functioning condition, they were instructed not to report a need for replacement, even if the system passed its expected useful life according to the industry standards.

The action levels for each observable system were defined precisely in training sessions and a series of handbooks, to assure consistency across individual inspectors.[7] Some systems require only an action level in order to estimate the repair cost; others require a type as well, specifying materials or size. For example, for bathroom floors, it is necessary to specify "type" of floor, because replacing a ceramic tile floor would be more costly than replacing a vinyl one. Minor defects that would be corrected through routine maintenance—e.g., replacing faucet washers—are generally excluded from inspection.

Inspectors used a set of five booklets to collect information on systems: Site Systems (SS), Mechanical Room (MR), Building Architecture (BA), Building Mechanical and Electrical (BME), and Dwelling Unit (DU) (both architectural and mechanical systems are included in dwelling unit). For each observable system, inspectors noted the presence or absence of each system, the age, remaining life, the type if appropriate, the number if appropriate (e.g., the number of windows), and the repair/replace action level associated with the observed condition.[8]

In addition to observing the physical condition of each system, the inspectors calculated property "take-offs." Using architectural drawings when available, or "pacing off" when no plans were available, the inspectors calculated the dimensions of site areas and distribution systems, the average square footage for all unit sizes at the property, and key building dimensions for all types and sizes of buildings. Take-off information was entered into the appropriate booklet. Take-off measurements were obtained for every building type in the property and every bedroom size category. Thus, we had direct measurements and did not have to impute square footage of any configuration. This approach is different from the 1998 study, in which we estimated average square footage for various unit sizes. The direct measurement produces better cost estimates.

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7 On-Site Insight. *The OSI Field Guide for Physical Needs Assessments*. Boston, MA: On-Site Insight, 2008.

8 The inspections excluded observations related to detecting or abating hazards due to the presence of asbestos or lead paint. At the time the study was designed, neither the information needed to categorize the presence and level of these hazards nor the optimal abatement methods (and costs) were available. With regard to energy, observations included specific energy-consuming systems (that is, the components or technologies directly or indirectly related to energy consumption, such as boilers and insulation) , but their energy-consuming properties could not be directly observed. Rather, the energy-consuming properties of systems were determined through a combination of direct observation of the condition of major equipment, windows, and appliances, and through inference from the year of installation or type of equipment. Water-consuming systems were similarly included, but their water-consumption characteristics were not observed directly; the consumption characteristics for these were also inferred based on their year of installation or type of equipment.

Over the course of the data collection, inspectors conducted physical inspections on many different systems. The following exhibit (2-1) lists some of the key types of systems that were covered.

Exhibit 2-1. Key Type of Systems Covered During a Physical Inspection

SITE SYSTEMS (SS)

- Sidewalks
- Landscaping
- Irrigation Systems/Drainage Systems
- Fencing and Retaining Walls
- Site Lighting
- Site Power Distribution
- Site Water Main
- Gas and Water Lines
- Sanitary Lines

BUILDING ARCHITECTURE (BA)

- Basement
- Foundation
- Exterior Wall and Ceiling
- Hallways Wall, Ceiling, and Floor Surface
- Roofs and Parapet Walls
- Doors and Windows
- Exterior Stairs
- Activity Rooms
- Community kitchen
- Lighting

MECHANICAL ROOM (MR)

- Boiler
- Boiler Room Piping and Valves
- Domestic Hot Water (DHW) Generation
- DHW Pumps
- Heating Water Circulation
- Combustion Air

BUILDING MECHANICAL & ELECTRICAL (BME)

- HVAC Equipment
- Fire Suppression
- Elevator
- Hot & Cold Water Distribution
- Gas Distribution
- Sanitary Waste & Ventilation

DWELLING UNIT (DU)

- Wall, Ceiling, and Floor Surface
- Doors
- Closet
- Kitchen
- Plumbing Fixtures
- Bathroom Accessories
- Unit HVAC
- Unit Electrical

For each sampled property, inspectors also collected information on units and buildings *not* inspected. In particular, the inspector asked the property manager to complete an Inspection Building and Unit Type (IBUT) form, which was used to obtain overall information on the types of buildings and units contained in the property. Before the site visit, the inspector sent an IBUT form to the site manager. For each building in the property, the manager was asked to record the building type (high-rise, walk-up, etc.) and whether building was on-line or off-line.[9] In addition, for each building, the form requested information about the number of units by size, and, for each size category, the number of occupied units and the number of vacant units.[10] When the inspectors arrived on-site, they reviewed and confirmed the data on these forms with the site managers.[11]

From this description of the property, the inspectors selected the buildings and units to inspect. Our approach to sampling buildings and units generally called for sampling at least one of each building type and at least one of each sized unit (defined by number of bedrooms).

The information from the IBUT form was used to apply the observations for the inspected buildings and units to the uninspected buildings and units of the same types. If more than one building or unit of a specific type was inspected, the average across the inspected buildings or units was applied to the uninspected buildings or units of the same type.

We generally requested that the on-site property manager or another knowledgeable person accompany the inspector during the inspection. The escort often provided information on recent modernization activities and upcoming activities that the inspector was able to use as part of the observation—for example, providing ages of some systems.

2.2. Estimating Costs

This section describes the approach used to transform the observations made by inspectors into repair and replacement costs. The first section presents the method for arriving at the costs of existing capital needs or backlog costs. We then outline the method for estimating the costs of future accrual of additional capital needs. A more detailed description of the methodology can be found in Appendix C.

Estimating the Costs of Existing Capital Needs

The estimation of total existing or backlog capital needs involves eight steps:

1. Conducting a physical inspection of the site systems and up to 4 buildings and 4 units within each property in the sample;
2. Generating a system-level cost file providing, for each of the approximately 321 systems inspected, a cost associated with each of the possible action levels for that system;

9 The PHA survey asked for reasons any buildings were off line (ready for demolition, recent natural disaster, being modernized, etc.) and the expected duration (permanently off line or expected to be back and when). The survey also asked about reasons for vacancy among vacant units (turnover, being modernized, permanently off-line, etc.).

10 To ensure that there were no more than four bedroom size categories, we counted as a single size category all 3+ bedroom units.

11 To reduce the burden on property managers for properties with large numbers of buildings, the managers were asked to complete a consolidated IBUT (C-IBUT) form that summarized the information by building type and size.

3. Calculating system-level costs for the property's site and for *inspected* units and buildings;
4. Inferring costs for *uninspected* units and buildings from the inspected units and buildings, and using them to generate property-level costs;
5. Adjusting the property-level costs for regional cost differences;
6. Applying markup factors to the direct costs to take into account the indirect costs of real estate development;
7. Estimating needs for the public housing stock and for various subgroups of PHAs based on the cost estimates for the *inspected* properties; and
8. Adding cost estimates for groups of properties and categories of need not included in the inspection-based estimates.

The physical inspections (step 1) were described in Section 2.1. Here we describe steps 2-7.

Step 2: System-level Cost File

The estimated cost of carrying out the repair actions noted by the inspector is computed off-site, after the inspection, using a cost file and algorithm. The cost file includes up to five system-specific, categorized levels of repair, ranging from no action to replacement of a system. These correspond to the action levels inspectors use to describe needed repairs. Recall that each action level for each system is associated with a specific, pre-specified set of repairs. The cost file assigns a cost to each action level. For example, a "minor" repair to kitchen cabinets/countertops/sinks was defined in terms of certain specific repairs; the cost file assigns a dollar cost to them, representing the cost for a unit needing "minor" repair of that kitchen system. The "moderate" costs associated with kitchen cabinets/countertops/sinks are a higher dollar amount per unit needing them; "major" costs are higher still, and so on. Not all systems have five action levels. Some have fewer, as appropriate.

In some cases, costs are provided not only based on the observed condition, but also based on specific features of the system such as size and materials used. For example, for foundations, there are seven different materials and three sizes for a total of 21 different costs for a "minor" action on foundations. For the Multifamily Stock Study and the 1998 Capital Needs Study in which this methodology was refined, we obtained the services of A.M. Fogarty and Associates, a firm with extensive experience in costing for both public and private housing construction and repair, to define and provide costs for each combination of system and action level. For this study, A.M. Fogarty and Associates again provided the cost estimates for the cost file.

Step 3: System-level Costs for the Site and Inspected Units and Buildings

In this step, the inspector's observations and the cost files are combined to calculate, for each property, repair costs for inspected items. A mathematical algorithm is applied to each system the inspector checked off as needing some level of repair. The basic concept is multiplying unit cost by a quantity measure, where the quantity measure may be scaled by the percentage of the item affected. For example, if only a portion of a roadway needs repair, the cost would be computed by multiplying the average cost per square foot by the portion of the roadway (in square feet) needing repair. Let us suppose that a 25,000 square foot roadway needs "minor" repair ("minor" repair for roadways is defined as "patch a pothole or swale and repave, and regravel the area") for less than 10 percent of the road. The algorithm would be: (the cost per square foot for a minimum action) * 25,000 (number of square feet) * 0.10 (percent of the roadway affected). The costing algorithm would specify a different cost per square foot for higher levels of action (moderate/major/replacement) because more work is required, as per the action level definitions.

Some of the algorithms make use of the take-off data; this cost element may be on a per linear foot or a per square foot basis, as in the above example on roadways. Other cost algorithms are based on the number of systems, such as the number of windows that require the action.

After the per-system costs are calculated, they are grouped together to form larger analysis groups. For example, kitchen walls, ceilings, floors, cabinets, countertop, sink, faucet, disposal, dishwasher, range, range hood, and refrigerator would be grouped together into an analysis group called "kitchen." These analysis groups are further aggregated into the five main system groups: Site Systems, Mechanical Room, Building Architecture, Building Mechanical and Electrical, and Dwelling Unit.

Step 4: Costs of Uninspected Units and Buildings and Property-Level Costs

A key issue in generating costs for the property as a whole is computing costs for buildings and units that were not inspected. For each property, costs for uninspected buildings and units are imputed based on costs generated for similar buildings and units in the same property that were inspected. For this, we use information obtained from the Inspector Building and Unit Type (IBUT) form. To estimate the costs for uninspected units, we multiply the number of uninspected units by the average repair costs for inspected dwelling units of the same size category. Estimating the costs for uninspected buildings is similar. We multiply the number of uninspected buildings by the average building-level costs for the inspected buildings of the same type.

We do not need to impute costs for site systems because we inspect the entire site on which the selected property is located.

Step 5: Adjustments for Regional Cost Differences

The cost file developed by A.M. Fogarty and Associates is based on national average costs in 2008[12]. Using the RSMeans location factors from the 2008 version of the Means Square Foot Costs Book, the property level cost estimates were adjusted by multiplying them by the ratio of the RSMeans index for the city where the property is located to the index for the national average (100). For example, the computed cost for a New York City property would be multiplied by 1.33 because costs in New York City are 33 percent higher than the national average.

Step 6: Adjustments for Indirect Costs

The cost files include only the direct costs of repairs and replacements—the costs of materials and labor. Real estate development and modernization also involve indirect costs. Indirect costs must be added to the direct costs in order to show the full cost of work done to address capital needs.

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12 The cost file was developed in early 2009 using 2008 data. Given the slowdown in construction that has continued since that time, our costing experts determined that it was not necessary to adjust costs to 2010 dollars.

As we did in the 1998 capital needs study and in our assessment of HUD's multifamily housing stock, we applied "markup factors" to reflect indirect costs.

The markup factors are:

- **Overhead and profit**. These are the costs associated with the contractor's overhead—home office costs, insurance, administration, etc., as well as the contractor's profit. The mark-up for overhead and profit is 15 percent.
- **General conditions.** The general conditions markup covers expenses associated with job site startup. The expenses may include job site office expenses and furniture, portable toilets, utilities, performance bond, insurance, permits, temporary fences, temporary weather protection, trash disposal, and photographic records. The markup for general conditions is 10 percent.
- **Contingencies:** The contingency mark up of 4 percent is designed to control for any uncertainties that may arise as a project is executed: for example, discovering the need for hazard removal during a project or other unforeseen circumstances.[13]
- **Soft costs and costs for management of the project by the owner (the PHA):** This markup covers design, architect, and engineering costs associated with a modernization project. In addition, the PHA also incurs additional costs for supervising the modernization process. The markup for these two components is 17 percent.

The markups are applied in a compound fashion in the costing algorithm. Thus, the total mark-up structure increases costs by 54 percent (1.15*1.10*1.04*1.17 = 1.54).

Some of the markup factors differ somewhat between the 1998 study and this study. Consistent with current practice, the overhead and profit multiplier used was 15 percent in this study, and the general conditions multiplier was 10 percent. The contingency multiplier was 4 percent. In the 1998 study the combined multiplier for overhead, profit and general conditions was 20 percent, and no multiplier was applied for contingencies. In both 1998 and currently, the multiplier for soft costs and PHA management totaled 17 percent. Therefore, the total markup factor in 1998 was 1.40 (1.2*1.17 = 1.404), compared with 1.54 in the current study.

Step 7: Estimating Total Inspection-Based Needs for PHAs and Various Subgroups of PHAs. Once we had property level costs as calculated above, we applied the sampling weights to these observations to estimate costs for groups of PHAs and for the inspection universe of PHAs as a whole. As described in Appendix A, a number of adjustments were made to the initial sampling weights based on information gathered during the inspection process.

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[13] In times of rapidly increasing costs, all costs are also adjusted by an escalation factor to allow the contractor to recoup costs due to increases in prices between the timing of the estimate and the timing of the work. However, given the economic environment during the study period, no escalation factor was applied.

Step 8: Estimating Total Needs for all PHAs Including All Properties and Additional Categories of Need.
In order to avoid prohibitively expensive data collection costs, the inspection universe excludes certain PHAs and categories of properties. Developments located in Alaska, Hawaii, Guam, and the U.S. Virgin Islands were not included in the inspection universe. In order to obtain cost estimates for these properties, we applied the national average costs to the units in these locations, adjusted by the R.S. Means Index for the location.

There also are categories of need that were not observed directly through the inspections because of resource constraints. Costs to meet these needs were not part of the property-level estimates. The categories of need include modifications for accessibility for people with disabilities, abatement of lead paint and asbestos hazards, improvements for increasing energy and water efficiency (beyond what would occur when old systems are replaced with systems that meet current standards), and reconfiguration of units.

We added in estimates for lead paint abatement and modifications for accessibility for people with disabilities. The primary source of data for this is the PHA survey. In the survey, we asked PHAs for their estimates of the numbers of units requiring lead abatement and accessibility conversions and for their estimates of the costs of each based on their recent experience.

To some extent the costs of improvements for increasing energy- and water-efficiency already are included in the cost estimates, because the materials and assemblies to be used are assumed to meet current energy efficiency standards. However, we also added estimates of cost-effective incremental upgrades and early replacement of some systems.

As was the case in 1998, this study does not make estimates for the costs of reconfiguring units.

Section 3.3 and Appendix D describe in more detail the methods for adding in the costs of PHAs and properties not included in the inspection universe and the costs of types of need not observed and recorded by the inspections.

Estimating Accrual Costs

Accrual costs are the costs a property will need to spend to cover expected repairs and replacements for each system over each of the next 20 years. Each system is given either a repair or a replacement cost depending upon its standard wear. For example, roof coverings are expected to be replaced after a certain number of years, but the building's exterior walls require only periodic major maintenance rather than replacement. Some systems are inappropriate for accrual estimates because they generally do not need replacement or standard maintenance over the 20-year horizon used for this study. For example, site slabs have an estimated useful life of 99 years. In addition to a repair or replacement cost, each system is assigned a useful lifetime, or, in the case of items which must be repaired periodically, an "action-interval." For systems requiring replacement over time, the useful life is the age of the system when it must be replaced because it is worn-out or approaching failure. For example, dwelling unit refrigerators are expected to last 15 years. This is the expected life for the dwelling unit refrigerator system.

For each of the next 20 years, for each system subject to accrual of needs, we assess whether the system will reach the end of its useful life (or action interval) that year. In any year that a system has reached its expected life, then the repair/replacement cost is added into the accrual total for that year.

The remaining useful life estimates are made by the inspectors using their professional judgment based on system age and observed condition. This is in contrast with the 1998 study in which every over-age system was assumed to need replacement at the end of its useful life. For example, take the case of an exterior unit door that is 20 years old. The expected useful life table indicates that this door should last for 25 years. If the inspector observed any of a number of conditions (e.g., frame is warped, bent or severely damaged from fire, vandalism, or water and has buckled, warped or broken), he or she would lower the remaining useful life by five years, calling for immediate replacement and including the replacement in current needs. However, the inspector may also indicate a life expectancy beyond the useful-life estimate if the door is in good condition, extending the useful life of the particular observed door to 27 or 28 years. In a strictly formula-based model, the door would be replaced at age 25 regardless of current observed condition.

The yearly accrual costs were calculated for the sites, units, and buildings that were actually inspected. These costs were then scaled up to reflect the total property, using the same scaling factors developed for estimating the property-level costs of existing or backlog needs. The property totals were adjusted for regional cost differences and for indirect costs as discussed previously. Accrual costs are based on current, 2010 dollars, rather than dollars for the year in which the repair or replacement will take place.

This approach to estimating accrual is similar to the method used in the 1998 public housing capital needs study and in the studies of the capital needs of the HUD-Insured multifamily stock. It relies on the assumption that all backlog needs are met. A more realistic method of estimating accrual needs might be to assume that, in reality, not all backlog needs are met in a timely manner. Not addressing existing needs could result in higher accrual needs in the future. Not only would the existing needs remain, but the costs of meeting the needs would go up because systems that might have been repairable would need to be replaced. For example, by comparing the average accrual costs that result from delayed repairs with the repair costs for systems that are addressed in a timely manner, analysis conducted following the 1985 public housing modernization (capital needs) study estimated that failing to meet existing needs adds an additional 8.7 percent to annual accrual estimates.[14]

[14] ICF, *Future Accrual of Capital Repair and Replacement Needs of Public Housing, Final Report,* April 1989. The ICF study's base case assumed, as we do, that modernization needs are met in a timely manner.

Chapter Three. Estimates of Capital Needs in 2010

This chapter provides cost estimates for the two fundamental measures of capital needs: existing needs and accrual needs. Sections 3.1 presents the inspection-based estimates of need based on the inspections conducted at a sample of PHAs and properties representative of most of the public housing stock, the inspection universe. Section 3.2 reports the results of an analysis of key drivers of these costs—that is, which systems account for most of the costs—and of how needs and costs differ by region, occupancy type, and predominant building type in the development. Section 3.3 then adds the costs estimated indirectly for PHAs and properties outside the inspection universe and for types of need not included in the inspections to produce national estimates for the entire public housing stock. Finally, Section 3.4 describes capital needs that might be addressed by PHAs that are not included in the national estimates.

3.1. Inspection-Based Estimates of Capital Needs

Existing Capital Needs or backlog needs are the costs of repairs and replacements required to make the housing decent and sustainable. This includes all capital costs associated with repairing or replacing systems with immediate repair needs to restore them to working condition. It does not include costs for routine maintenance. The inspection-based estimates of needs do not include the costs of detecting or abating special hazards such as asbestos or lead paint, modifications for accessibility for people with disabilities, or improvements for the explicit purpose of increasing energy or water efficiency. For the national total estimates of the costs of existing capital needs presented later Section 3.3, we have added approximations for these components of need.

The methodology used to generate the estimates is generally similar to that used in the 1998 study. However, some improvements were made to the methodology, and some assumptions were changed based on current best practices. As will be seen in this chapter and the next, the estimates are sensitive to assumptions made and methodology used.

Accrual Needs are the costs needed each year to cover expected ongoing repairs and replacements beyond ordinary maintenance, assuming that existing capital needs have been met. In any year that a system has reached its expected life, its repair/replace cost is added into the accrual total for that year. Accrual costs were calculated for each of the next 20 years. The study analysis presents the average accrual costs over the next twenty years.

Exhibit 3-1 presents inspection-based estimates of need for the following categories of PHAs:

- All housing authorities;
- All housing authorities except New York City, Chicago, and Puerto Rico;
- Housing authorities with less than 250 units;
- Housing authorities with 250 to 1,250 units;
- Housing authorities with 1,251 to 6,600 units;

- Housing authorities with more than 6,600 units (except for New York City, Chicago, and Puerto Rico);
- New York City Housing Authority;
- Chicago Housing Authority; and
- Puerto Rico Housing Authority.

To facilitate comparing physical needs across properties having different numbers of units, all costs are expressed on a per unit basis.

For each PHA category, we present the following information:

- The number of properties in the sample from that category of PHA;
- The number of sample properties defined as family-occupied. HUD's PIC data do not explicitly identify whether a property is family or elderly. For the purpose of this study, we defined family properties as those with average bedroom size at least 1.5, or those with an average bedroom size between 1.2 and 1.5 and at least 100 2+ bedroom units;[15, 16]
- The number of sample properties defined as elderly-occupied. We defined elderly properties as those with average bedroom size less than 1.5, except when average bedroom size is between 1.2 and 1.5 and the property has at least 100 2+ bedroom units; and
- The total number of *units* in the inspection universe for that category of PHA.

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15 The same analytical definition was used to identify family and elderly properties in the 1998 Formula Capital Study.

16 Among the agencies who completed the PHA survey, we also collected information on the overall count of units that are designated as family and elderly at the PHA level by the PHA staff. However, because of the aggregate nature of this information, it cannot be used in the cross tabulations presented in this chapter.

Exhibit 3-1. Inspection-based Estimates of Capital Needs

Housing Authority Size	All	All Except NYC, Chicago and Puerto Rico	<250 Units	250-1,249 Units	1,250-6,600 Units	6,600+ Units (Except NYC, Chicago, Puerto Rico)	NYC	Chicago	Puerto Rico
Sample Properties									
Overall	548	386	60	129	147	50	112	19	31
Family	400	256	44	82	93	37	110	4	30
Elderly	148	130	16	47	54	13	2	15	1
Inspection Universe Units	1,085,407	845,505	192,268	302,365	279,850	71,021	163,269	27,701	48,933
Inspection-based Estimate of Existing Need Per Unit									
Means									
Overall	$19,029	$17,318	$15,251	$15,572	$17,774	$28,553	$30,042	$12,359	$15,610
95% Confidence Interval	$17,520 to $20,537	$15,616 to $19,021	$11,002 to $19,501	$12,890 to $18,254	$15,196 to $20,352	$21,464 to $35,642	$26,535 to $33,550	-$1,809 to $26,526	$10,994 to $20,225
Family	$22,190	$20,424	$17,158	$17,967	$21,946	$34,228	$30,704	$17,783	$15,156
Elderly	$11,646	$11,936	$11,027	$11,263	$12,111	$16,585	$4,514	$2,514	$25,941
Median	$15,374	$12,485	$9,481	$10,867	$14,393	$20,712	$28,801	$4,319	$10,708
25th percentile	$5,248	$4,334	$4,335	$3,845	$4,207	$10,057	$18,130	$1,468	$5,361
75th percentile	$28,570	$25,715	$20,443	$23,812	$26,646	$40,971	$43,020	$16,837	$25,870
Total across All Units	$20,653,779,752	$14,642,641,286	$2,932,324,236	$4,708,338,577	$4,974,092,855	$2,027,885,617	$4,904,984,041	$342,339,464	$763,814,960
Average Annual Accrual Years 1-20 Per Unit									
Means									
Overall	$3,155	$3,218	$3,247	$3,320	$3,105	$3,154	$3,116	$3,195	$2,163
95% Confidence Interval	$3,060 to $3,250	$3,104 to $3,333	$2,948 to $3,547	$3,137 to $3,503	$2,920 to $3,290	$2,822 to $3,485	$2,981 to $3,252	$2,660 to $3,730	$1,907 to $2,419
Family	$3,415	$3,597	$3,599	$3,670	$3,527	$3,536	$3,130	$3,700	$2,191
Elderly	$2,547	$2,561	$2,468	$2,691	$2,532	$2,347	$2,595	$2,278	$1,530
Median	$2,995	$3,044	$3,030	$3,333	$2,945	$2,921	$2,971	$3,185	$2,018
25th percentile	$2,443	$2,469	$2,597	$2,503	$2,197	$2,406	$2,542	$2,490	$1,656
75th percentile	$3,790	$3,905	$3,711	$4,063	$3,862	$3,561	$3,633	$3,429	$2,627
Total across All Units	$3,424,286,269	$2,721,127,032	$624,333,827	$1,003,818,125	$868,979,006	$223,996,074	$508,806,894	$88,497,768	$105,854,574

Notes: Excludes units proposed/approved for demolition, HOPE VI and Turnkey, and excludes all units in Alaska, Hawaii, Guam, and the U.S. Virgin Islands. All dollars values are locally adjusted using the RS Means location adjustment factors.

For each capital needs measure, the exhibit presents the following statistics:[17]

- The per unit mean cost of existing need across all units;
- The mean for units in elderly properties;
- The mean for units in family properties;
- The 95 percent confidence interval around the mean;
- The median, 25th and 75th percentiles; and
- The total estimate of the cost of meeting existing need for all units in the inspection universe.

Inspection-based Estimates of Existing Capital Needs

- The national average estimate of existing capital needs is $19,029 per unit, with a median of $15,374 per unit.
- The total inspection-based capital needs estimate for the inspection universe is $20.7 billion in 2010 dollars.
- The average per unit inspection-based estimate of existing capital needs generally is higher for larger housing authorities than for smaller PHAs. However, needs are very similar for PHAs with fewer than 250 units and those with 250 to 1,249 units. The average sample-weighted estimate of needs is $15,251 for housing authorities with fewer than 250 units, $15,572 for housing authorities with 250 to 1,249 units, $17,774 for housing authorities with 1,250 to 6,600 units, and $28,553 in housing authorities with more than 6,600 units (excluding New York, Chicago and Puerto Rico).
- The estimates of existing capital needs per unit in Chicago and Puerto Rico are lower than other very large PHAs: $12,359 in Chicago and $15,610 in Puerto Rico. This results in part from extensive modernization programs at those housing authorities in

[17] The study team conducted Quality Control (QC) inspections on 52 out of the 548 sample properties, where inspections on the same property were performed independently by two different inspectors, often on the same day. We found that, in general, the estimate of existing capital needs is close between the QC and regular inspections for a majority of the cases: 62 percent are with differences within -10 and 10 percent. For about a quarter of the cases, the estimate of needs between the QC and regular inspections differs by more than 25 percent in absolute terms. The tabulation below shows the distribution of difference between the QC and regular inspections across the 52 sample properties.

Difference in Estimate of Existing Needs	Freq.	Percent
< -50%	3	5.8
-50% and -25%	4	7.7
-25% and -10%	3	5.8
-10% and 0%	14	26.9
0% and 10%	18	34.6
10% and 25%	3	5.8
25% and 50%	5	9.6
> 50%	2	3.9
Total	52	100.0

recent years.[18] In addition, in Puerto Rico, the capital costs for several expensive systems are not included in our estimates because they are generally owned by the tenants, rather than by the PHA. These system items often include domestic hot water generators, unit air conditioners, unit refrigerators, and unit ranges.

- The needs in NYC were similar to those of other very large PHAs, averaging $30,042 per unit.
- The 25th and 75th percentiles show the broad range of existing capital needs. Nationwide, one quarter of the units have needs of under $5,248 per unit, and one quarter have needs greater than $28,570.
- As expected, the estimate of existing capital need is substantially higher for family developments than for elderly developments, $22,190 versus $11,646 per unit.

Inspection-based Estimates of Accrual Needs

- Exhibit 3-1 presents the average annual accrual of repair needs over years 1 to 20 in 2010 dollars. Across the inspection universe of PHAs and properties and assuming that the existing capital needs were completely addressed, each year approximately $3.4 billion would be required to address the ongoing accrual needs, or on average of $3,155 per unit.
- One might expect accrual estimates to be similar to amounts privately-owned properties set aside for replacement reserves. Both amounts are intended to cover ongoing repairs and replacements beyond ordinary maintenance. In fact, our estimate of average annual accrual is significantly higher than the standard practice for replacement reserve deposits, which is generally under $400 per unit per year. There are several possible explanations for the study's higher estimate,
    - Private owners may pay for a portion of repairs out of ongoing operating revenues rather than from reserves.
    - Private owners often sell or refinance their properties in order to obtain funds needed to conduct periodic large scale property improvements.
    - The study estimates assume that all needed activities take place according to standard useful life tables. In fact, many owners delay conducting repairs, stretching out the lives of systems beyond the "useful" life. This reduces the annual expense.

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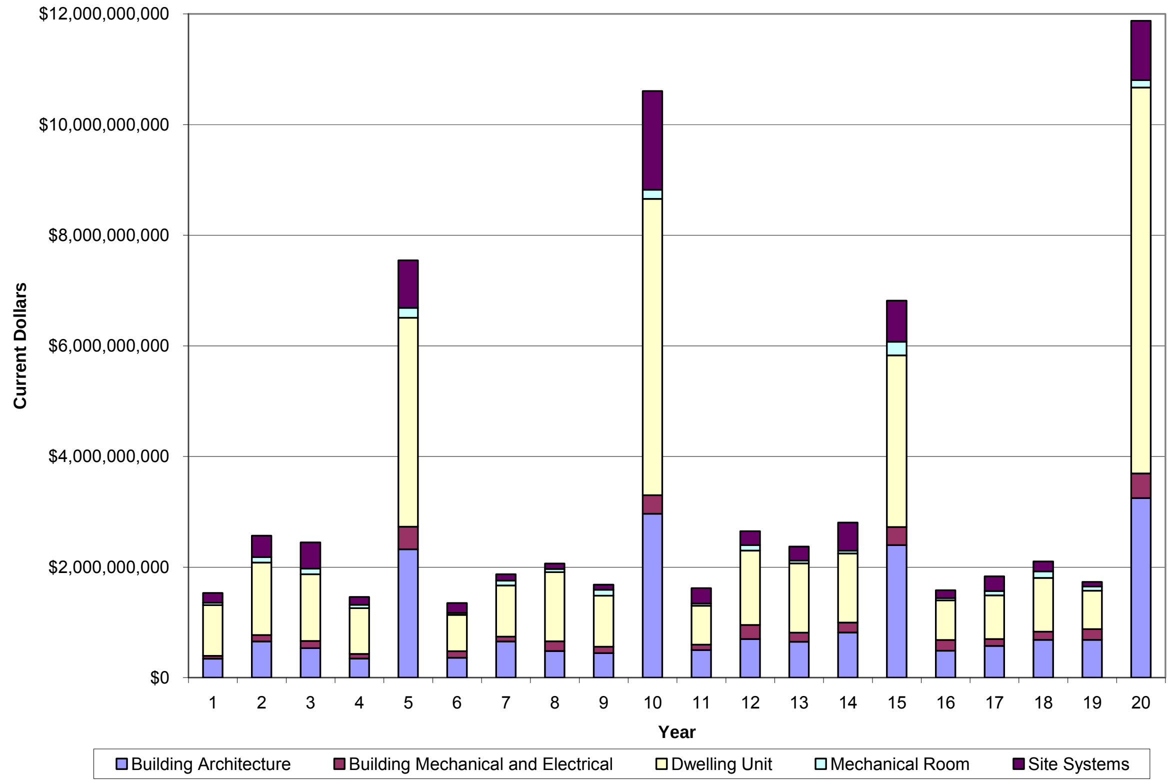
[18] In Chicago, the low estimate of needs is also partially a function of the sample. In each PHA, developments were selected at random with probability proportional to size, without regard to family/elderly status. A random sample will generally yield a representative sample. However, in Chicago, the entire stock is undergoing modernization. Many of the sampled family developments could not be inspected as they were in the process of being modernized. In contrast, the modernization effort for elderly developments was largely complete, so that elderly developments, with generally low capital needs, are over-represented in the sample for Chicago. Such issues did not arise in any other PHA. See the CHA's *FY2009 Moving to Work Annual Report*, March 31, 2010 for additional details. To account for the imbalance of family/elderly units in the Chicago sample, we have adjusted the sampling weights for these properties to reflect the ratio of family/elderly units in the sampling universe. This procedure is known as a poststratification adjustment to the sampling weights.

- Accrual costs, in an absolute sense, do not vary substantially across properties. The 25th percentile across all properties is $2,443 per unit; the 75th percentile is $3,790.
- Average annual accrual needs per unit are higher in smaller PHAs compared with those in the larger PHAs. This could be due to a combination of factors beyond the fact that large PHAs are often in higher cost areas. Many of the smaller agencies have newer housing stocks. On average, these properties are in better condition than those in larger agencies, as indicated by their lower level of average existing needs. Our algorithm for computing the accrual needs assumes that all existing needs are addressed right away. For newer properties, fewer systems have reached the end of their useful lives, so fewer systems are replaced and repaired as part of existing needs, and more as part of ongoing accrual. Consequently, average annual accrual needs are higher, as many systems will reach their life expectancy and need to be replaced over the next 20 years. Moreover, smaller PHAs have a higher proportion of walk-up and rowhouse buildings in their stocks, which tend to have fewer units per building. As a result, the accrual costs for these properties on a per unit basis are higher than in larger agencies.
- At $2,163, the average annual accrual in Puerto Rico is significantly less than the national average. This may be because in Puerto Rico, the capital costs for several expensive systems are not included in our estimates because they are generally owned by the tenants, rather than by the PHA. These system items often include domestic hot water generators, unit air conditioners, unit refrigerators, and unit ranges.
- Accrual costs are higher in family developments, about $3,415 per unit compared with $2,547 per unit in elderly developments. Life cycles are shorter for many systems in family developments because of higher wear and tear.
- Exhibit 3-2 presents accrual estimates by year. As can be seen in the exhibit, accrual costs are cyclical, with peaks every five years. This is because many of the system items have 5, 10, 15 or 20 year life cycles. This is particularly true for Building Architecture and Dwelling Unit systems. Site items are assumed to have a longer useful life and therefore they are less cyclical.

Exhibit 3-2. Distribution of Accrual Needs Across Years, By System



Total Capital Needs Over the Next 20 Years

To arrive at a measure of total capital needs, we combined the inspection-based estimates of existing needs with accruals for years 1-20. Exhibit 3-3 presents the distribution of the estimate of total capital needs across agency size categories and family/elderly occupancy types. It shows that the total capital needs over the next 20 years are approximately $89 billion for the inspection universe, or $82,125 on a per unit basis.

Exhibit 3-3. Inspection-based Estimates of Total Capital Needs over the Next 20 Years

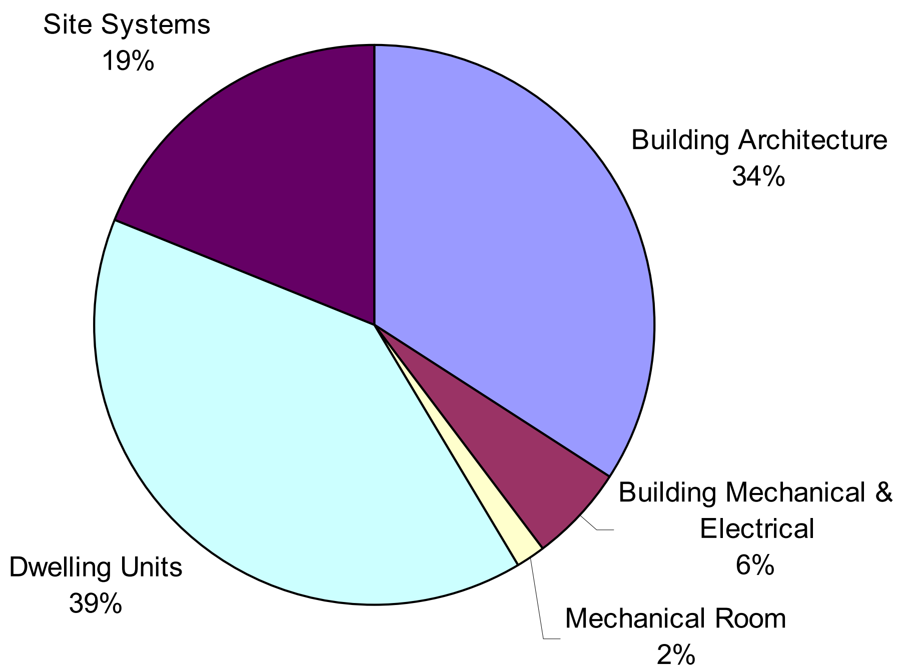
Housing Authority Size	All	All Except NYC, Chicago and Puerto Rico	<250 Units	250-1,249 units	1,250-6,600 units	6,600+ units (except NYC, Chicago, Puerto Rico)	NYC	Chicago	Puerto Rico
Sample Properties									
Overall	548	386	60	129	147	50	112	19	31
Family	400	256	44	82	93	37	110	4	30
Elderly	148	130	16	47	54	13	2	15	1
Inspection Universe Units	1,085,407	845,505	192,268	302,365	279,850	71,021	163,269	27,701	48,933
Inspection-based Estimate of Total Needs (Existing Needs and 20 Year Total Combined)									
Means									
Overall	$82,125	$81,685	$80,195	$81,969	$79,877	$91,632	$92,370	$76,254	$58,875
Family	$90,495	$92,374	$89,137	$91,361	$92,495	$104,957	$93,302	$91,787	$58,978
Elderly	$62,579	$63,163	$60,386	$65,074	$62,752	$63,530	$56,418	$48,067	$56,532
Median	$80,591	$79,578	$75,961	$79,769	$78,861	$89,512	$89,238	$88,367	$58,966
25th percentile	$63,335	$62,278	$62,886	$61,678	$59,872	$73,365	$79,772	$51,191	$49,578
75th percentile	$97,622	$97,516	$93,233	$96,996	$94,726	$110,606	$101,372	$94,025	$66,627
Total across All Units	$89,139,505,122	$69,065,181,927	$15,419,000,777	$24,784,701,067	$22,353,672,976	$6,507,807,107	$15,081,121,923	$2,112,294,823	$2,880,906,449

Notes: Excludes units proposed/approved for demolition, HOPE VI and Turnkey, and excludes all units in Alaska, Hawaii, Guam, and the U.S. Virgin Islands. All dollars values are locally adjusted using the RS Means location adjustment factors.

3.2. Key Drivers of Capital Needs

Exhibit 3-4 shows the distribution of existing capital needs by major system groups: Site Systems, Building Architecture, Building Mechanical and Electrical, Mechanical Room, and Dwelling unit. Exhibit 3-5 shows the same distribution for accrual costs.

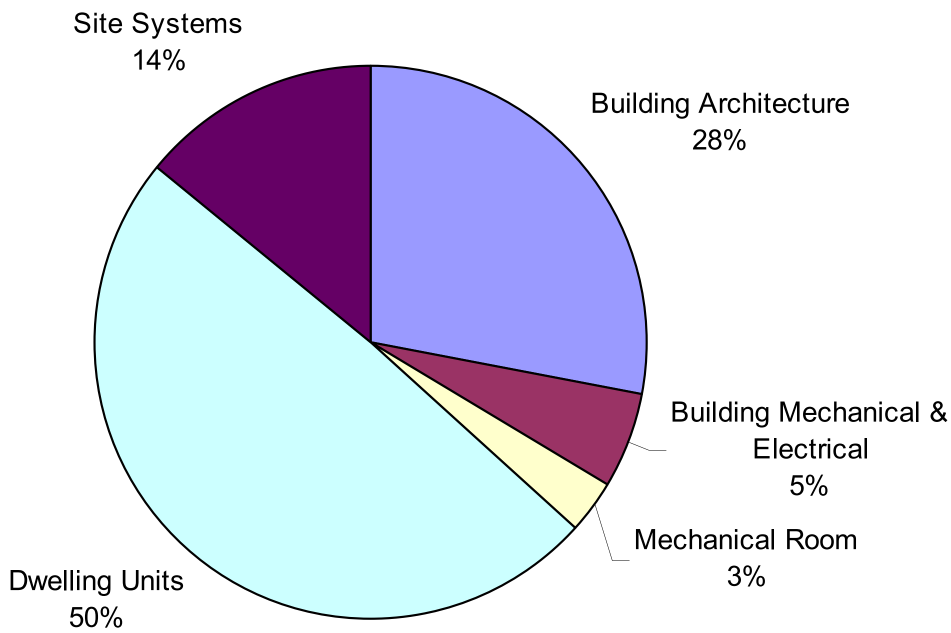
Exhibit 3-4. Inspection-based Estimates of Existing Need By System Type



Key findings regarding drivers of existing needs and accrual costs are:

- The largest contributors to existing capital needs are systems within dwelling units such as kitchens, baths, and interior doors, which account for 39 percent of all needs.
- Building architecture systems (e.g., windows, exterior doors, roofs) are the second largest contributors, at 34 percent of existing capital needs.

Exhibit 3-5. Average Annual Accrual Years 1-20 by System Type



- Systems at the dwelling unit level account for half of annual accrual costs, and building architecture systems account for 28 percent. Dwelling unit systems tend to need replacement on a more frequent cycle compared to building and site-level systems. This is why dwelling unit systems contribute more to annual accrual compared with the backlog.

Exhibit 3-6 provides additional detail on the key cost drivers for existing or backlog needs. Exhibit 3-7 presents similar information for accrual needs.

Exhibit 3-6. Cost Drivers for Existing Modernization Needs

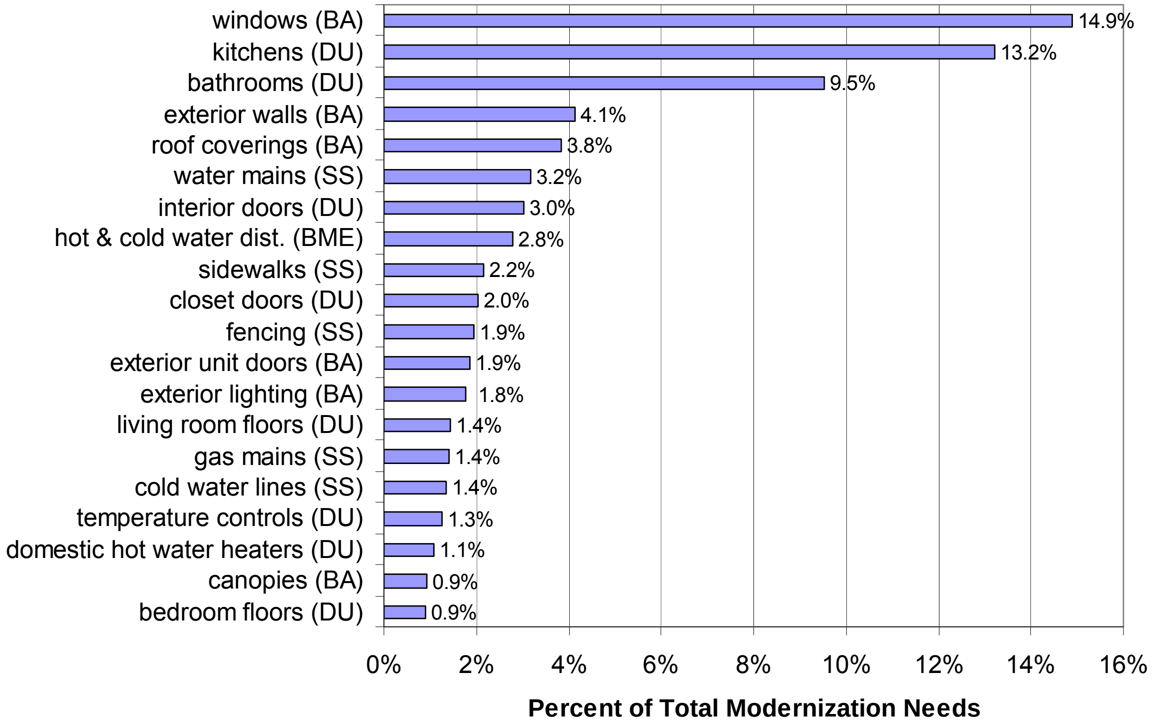
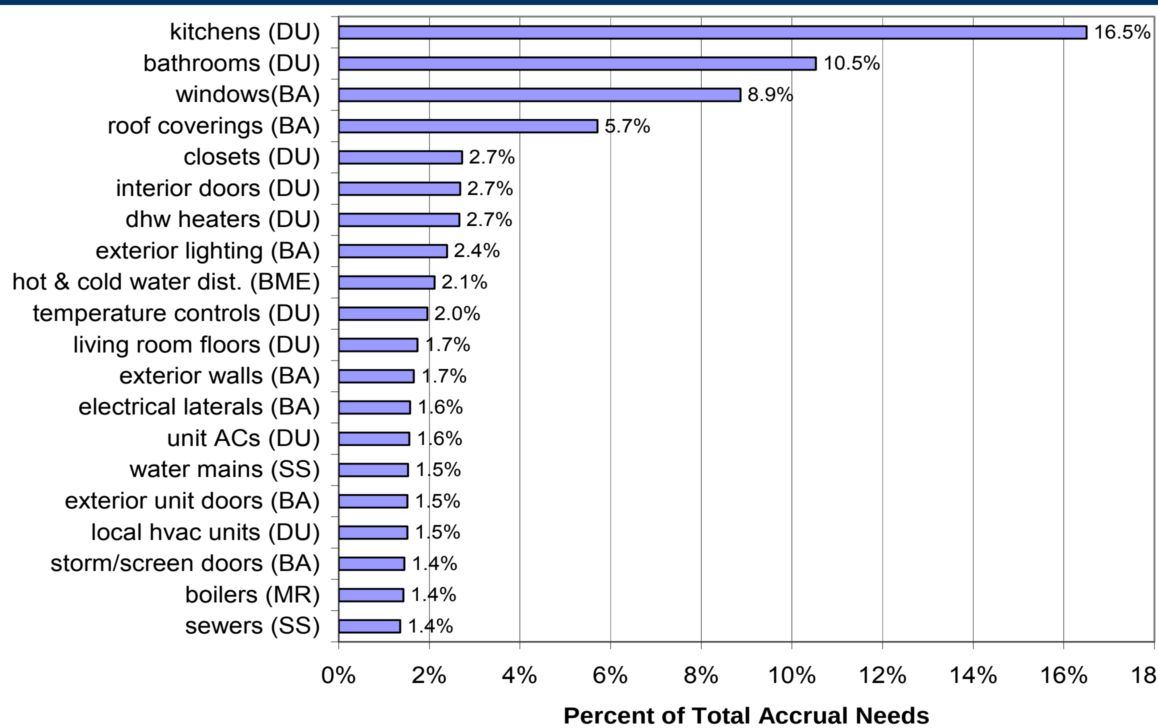


Exhibit 3-7. Cost Drivers for Accrual Needs



The key cost drivers for both existing needs and ongoing accrual of needs are windows, kitchens, and bathrooms, though the order differs between existing needs and accrual needs.

- These three systems combined account for nearly 40 percent of all existing capital needs. Windows alone account for about 15 percent of need.
- Kitchens contribute the most to accrual needs. Kitchens are present in every unit, and appliances, floors, and cabinets have relatively short useful lives, particularly in family developments.

In addition to looking at the key contributors to overall costs, we can look at the percentage of properties that have each kind of deficiency. Exhibit 3-8 displays this information for existing needs, and Exhibit 3-9 for accrual needs.

- Exhibit 3-8 shows that, while windows are the largest component of costs, windows need repair or replacement in only about 37 percent of properties.
- About 80 percent of properties require some action in the two second highest cost drivers, kitchens and baths.
- Sidewalks also needed repairs or replacements in many properties, more than 60 percent.
- Exhibit 3-9 shows that all properties will need some activity in kitchens and bathrooms over the next 20 years. This is because many of the items in these two system groups have life cycles that are shorter than 20 years. Even if the whole kitchen were replaced as part of addressing existing needs, additional replacements would be needed within the next 20 years.
- The exhibit also shows that nearly all properties (96 percent) will need roof repairs or replacements during the next 20 years, and most will need repair or replacement of living room floors, exterior lighting, temperature controls, interior doors, closet doors, windows, and exterior walls.

Exhibit 3-8. Top 20 Existing Needs Cost Drivers: Percent of Properties that have Each Need

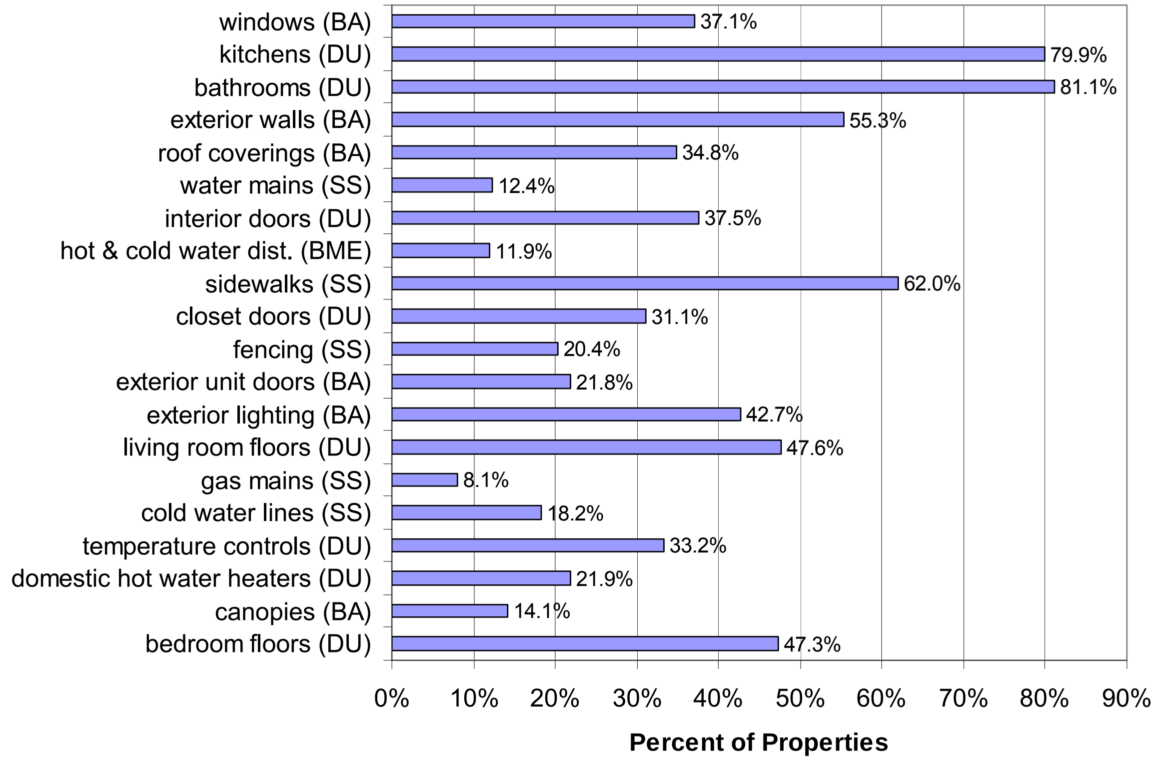
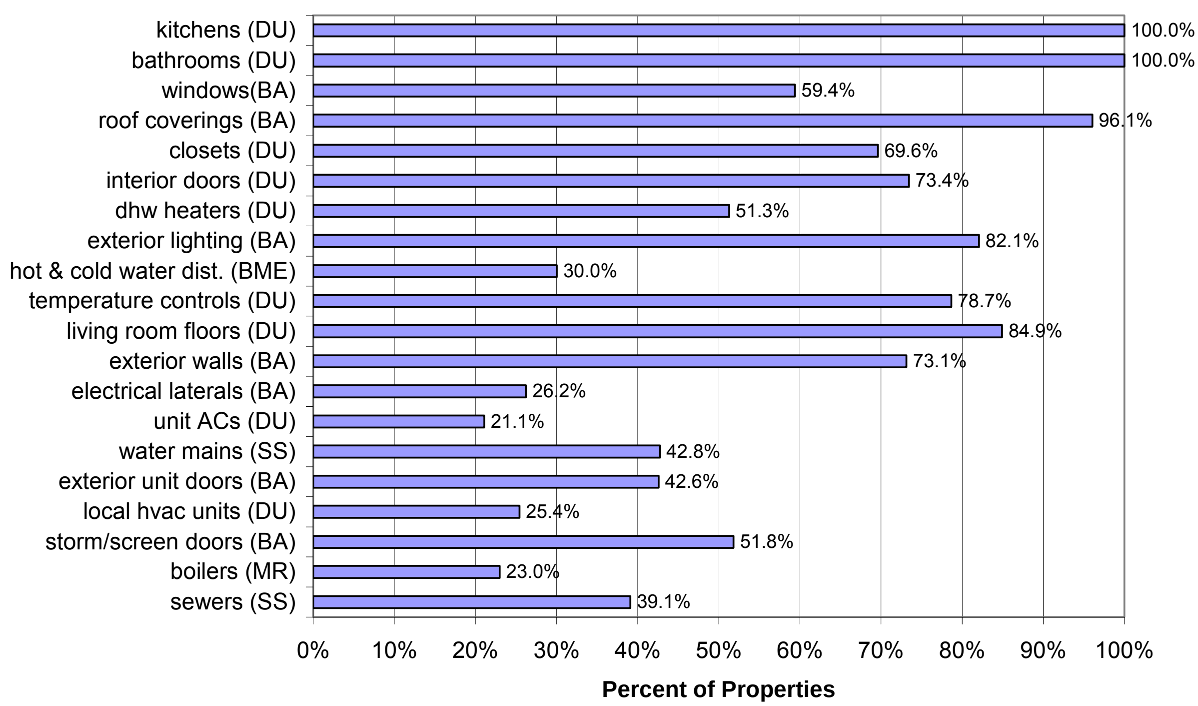


Exhibit 3-9. Top 20 Accrual Cost Drivers: Percent of Properties that have Each Need



Capital Needs by Region and Building Type

Exhibit 3-10 and 3-11 compare the inspection-based existing needs and accrual needs by region and building type.

Regional Differences

Exhibit 3-10 compares the inspection-based estimates of existing capital needs for the four Census regions. The exhibit shows:

- On a per unit basis, existing capital needs are highest in the West, at $39,221 per unit. This is partly driven by the condition of the units in this region and partly by cost variations by region. As described in Chapter 2, all costs were adjusted based on the RSMeans location cost index. The weighted mean adjustment factors by region are: 10 percent higher in the Northeast, 5 percent higher in the West, 1 percent lower in the Midwest, and 16 percent lower in the South. Cost adjustments in the West are higher than average national costs, but not as high as costs in the Northeast.
- Many of the properties in the West were built and placed in service later than other public housing in the country and thus have not gone through the early cycle of modernization. As a result, they should have higher existing needs. This is reflected in the weighted average age of the system items reported by the inspectors—34 years for properties in the West versus 28 years for the rest of the stock. Another contributing factor is that a substantially larger portion of the units in the West are in rowhouse/townhouse building types (70 percent vs. 45 percent nationwide). As we will discuss in the next section, compared to other building types, rowhouse/townhouse buildings have the highest capital needs on a per unit basis.
- Inspection-based capital needs are lowest in the Midwest, at only $9,507 per unit. This lower needs estimate is not driven by the Chicago PHA properties, as excluding them yields an almost identical estimate. A closer examination reveals that the region contains a significant proportion of elderly units (about 51 percent vs. about 30 percent nationwide), which on average have lower per-unit repair needs.
- Existing capital needs in the Northeast averaged $22,418 per unit. To some extent these high needs are driven by very high costs in New York City, but they are partially offset by lower than average needs in Puerto Rico.[19] The weighted average location adjustment for properties in New York City is 27.6 percent. This implies that, to a very large extent, the high cost estimate for New York is due to the higher costs in that area, rather than to greater physical needs. Excluding these two sites, average capital needs in the Northeast were $17,600 per unit.
- Existing capital needs averaged $16,268 in the South, which is somewhat lower than the national average largely due to lower costs in the region.
- Accrual needs do not vary substantially by region. They are highest in the West, but the regional difference is not nearly as great as for existing capital needs.

19 The U.S. Census does not assign Puerto Rico to any of the Census regions. For this study, we included Puerto Rico in the Northeast.

Differences by Building Type

In order to compare costs by building type, we assigned each development a predominant property type based on the majority of units in the property. The building types are high-rise/elevator, walk-up/garden, rowhouse/townhouse, and single-family detached/semi-detached[20]. Exhibit 3-11 shows that:

- Existing capital needs do not vary substantially by building type. Needs are highest for walk up/garden apartments and rowhouse/townhouse properties, averaging approximately $20,000 per unit for both building types. Needs are higher for these building types on a per-unit basis, in part because they have few units per building.
- Existing capital needs for properties that are predominantly high-rise/elevator buildings average $17,586 per unit.
- Although the average need does not vary substantially by building type, the key drivers of needs do. Windows, closet doors, kitchens, bathrooms, exterior walls, interior doors, roof coverings, living room floors and sidewalks are among the top 20 cost drivers for all building types. However, boilers, heating supply, HVAC radiation, heating returns, sanitary waste and vents, fire suppression, and hallways are among the top 20 cost drivers in high rise properties, but not in other types. Walk-up/garden properties tend to be on larger physical sites, so key drivers in these properties also include gas mains, heating risers and distribution, cold water lines, and gas lines, as well as basement floors, and balconies. In addition to the cost drivers that are common across all properties, cost drivers in rowhouses/townhouses include domestic hot water, electrical laterals, canopies, storm/screen doors, landscaping, and sanitary lines. Fences, exterior unit doors, exterior lights, and water mains are among the key drivers in both walk-up and rowhouse/townhouse developments.
- Exhibit 3-12 shows the contribution of the top 6 systems to costs for the three main development types. As shown in the exhibit, windows account for 23 percent of existing modernization needs in high-rise properties, and kitchens and bathrooms account for about 15 and 10 percent respectively. Thus, these three systems alone account for nearly half the existing needs in high-rise properties. These three systems account for only 29 percent of costs in walk-ups and 34 percent in row-house townhouse developments.

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[20] The study sampling procedures eliminated all single family detached properties, as well as scattered site properties that were considered low density, those with fewer than 1.5 units per building. A small number of scattered site properties with single family attached units were not considered low density, and thus were included in the study.

Exhibit 3-10. Inspection-based Estimates of Capital Needs by Census Region

Census Region	All	Northeast	Midwest	South	West
Sample Properties					
Overall	548	239	91	178	40
Family	400	196	41	134	29
Elderly	148	43	50	44	11
Inspection Universe Units	1,085,407	403,265	208,666	389,508	83,968
Inspection-based Estimate of Existing Need Per Unit					
Means					
Overall	$19,029	$22,418	$9,507	$16,268	$39,221
95% Confidence Interval	$17,520 to $20,537	$20,094 to $24,741	$6,910 to $12,103	$14,159 to $18,377	$32,112 to $46,331
Family	$22,190	$25,433	$11,792	$17,774	$44,421
Elderly	$11,646	$12,671	$7,284	$11,961	$25,801
Median	$15,374	$19,553	$5,131	$12,634	$35,273
25th percentile	$5,248	$7,734	$3,148	$5,502	$24,136
75th percentile	$28,570	$34,621	$14,641	$23,786	$53,248
Total across All Units	$20,653,779,752	$9,040,272,416	$1,983,700,043	$6,336,477,890	$3,293,329,404
Average Annual Accrual Years 1-20 Per Unit					
Means					
Overall	$3,155	$2,987	$3,159	$3,265	$3,437
95% Confidence Interval	$3,060 to $3250	$2,858 to $3116	$2,926 to $3,392	$3,104 to $3,426	$2,984 to $3,890
Family	$3,415	$3,133	$3,968	$3,426	$3,865
Elderly	$2,547	$2,517	$2,373	$2,807	$2,331
Median	$2,995	$2,840	$3,001	$3,141	$3,191
25th percentile	$2,443	$2,371	$2,465	$2,502	$2,697
75th percentile	$3,790	$3,515	$3,675	$3,965	$4,303
Total across All Units	$3,424,286,269	$1,204,616,900	$659,192,145	$1,271,886,136	$288,591,087

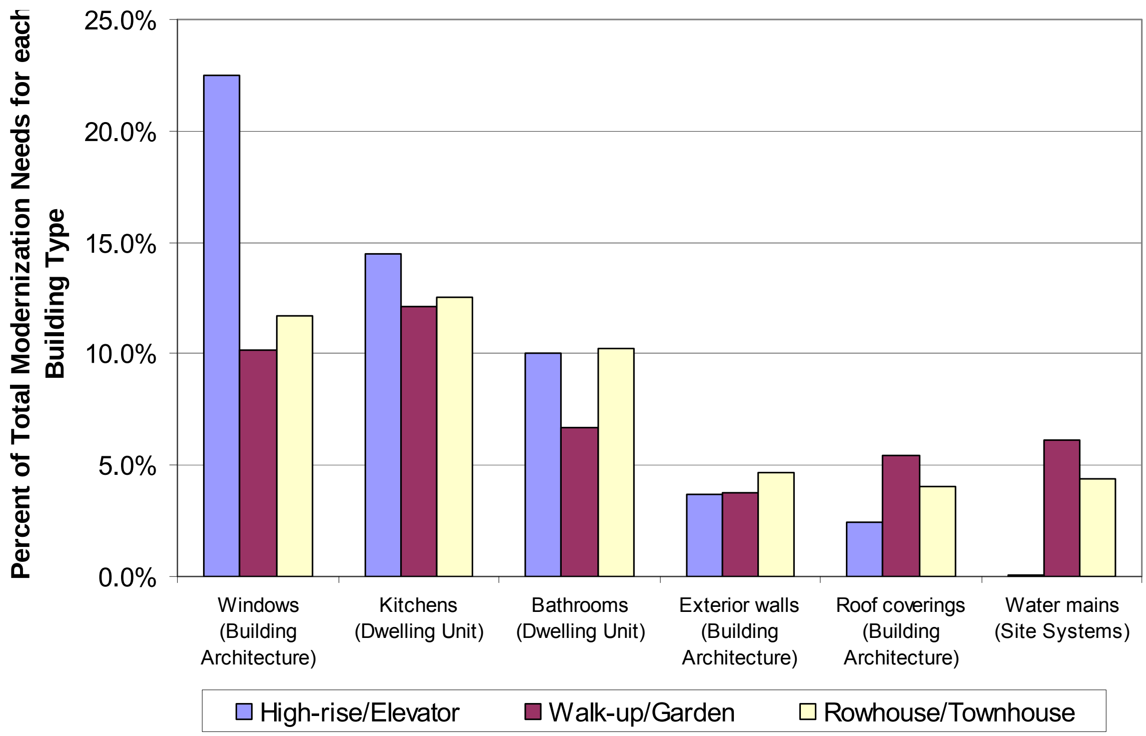
Notes: Excludes units proposed/approved for demolition, HOPE VI and Turnkey, and excludes all units in Alaska, Hawaii, Guam, and the U.S. Virgin Islands. All dollars values are locally adjusted using the RS Means location adjustment factors.

Exhibit 3-11. Inspection-based Estimates of Capital Needs by Predominant Building Type

Predominant Building Type	All	High-Rise/Elevator Structure	Walk-up/ Garden	Rowhouse/ Townhouse	Single-family Detached/ Semidetached
Sample Properties					
Overall	548	229	88	223	8
Family	400	114	72	206	8
Elderly	148	115	16	17	0
Inspection Universe Units	1,085,407	422,503	157,065	486,121	19,718
Inspection-based Estimate of Existing Need Per Unit					
Means					
Overall	$19,029	$17,586	$19,899	$20,085	$16,967
95% Confidence Interval	$17,520 to $20,537	$15,341 to $19,831	$16,202 to $23,596	$17,637 to $22,533	$8,621 to $25,314
Family	$22,190	$26,824	$22,005	$20,645	$16,967
Elderly	$11,646	$11,085	$12,104	$14,456	$0
Median	$15,374	$13,991	$17,647	$15,436	$13,326
25th percentile	$5,248	$3,981	$6,515	$5,952	$7,827
75th percentile	$28,570	$26,326	$29,734	$30,005	$24,358
Total across All Units	$20,653,779,752	$7,430,135,977	$3,125,397,517	$9,763,688,855	$334,557,403
Average Annual Accrual Years 1-20 per Unit					
Means					
Overall	$3,155	$2,754	$2,951	$3,553	$3,553
95% Confidence Interval	$3,060 to $3,250	$2,633 to $2,875	$2,734 to $3,168	$3,411 to $3,695	$2,213 to $4,893
Family	$3,415	$3,259	$2,969	$3,595	$3,553
Elderly	$2,547	$2,398	$2,884	$3,126	$0
Median	$2,995	$2,649	$2,827	$3,585	$2,822
25th percentile	$2,443	$2,157	$2,224	$2,802	$2,188
75th percentile	$3,790	$3,221	$3,481	$4,239	$4,071
Total across All Units	$3,424,286,269	$1,163,583,740	$463,494,359	$1,727,152,799	$70,055,371

Notes: Excludes units proposed/approved for demolition, HOPE VI and Turnkey, and excludes all units in Alaska, Hawaii, Guam, and the U.S. Virgin Islands. All dollars values are locally adjusted using the RS Means location adjustment factors.

Exhibit 3-12. Percent of Total Modernization Needs for each Building Type for the Top 6 cost Drivers Overall



3.3. Estimate of Total National Existing Capital Needs

The inspection-based estimates do not include all categories of units or all categories of capital needs. Exhibit 3-13 presents our best estimate of existing capital needs for the nation as a whole. This estimate includes the inspection-based estimates plus estimates that account for the categories of need and categories of properties not included in the inspections. Estimates for these categories of need are based on several sources, as described below.

Exhibit 3-13. National Estimates of Total Existing Modernization Needs

	Number of Units	Total Cost
Estimate for Inspection Universe (includes scattered site units)	1,085,407	$20,653,790,000
Addition for Alaska, Hawaii, Guam, USVI	10,596	$233,514,000
Addition for Lead Paint Abatement	62,000	$306,788,000
Addition for Accessibility for Disabled	10,684	$264,473,000
Addition for Moderate Energy and Water Efficiency Improvement	1,085,407	$4,149,439,000
TOTAL Estimate of Existing Modernization Needs		**$25,607,994,000**
Per Unit		**$23,593**

Estimates for Alaska, Hawaii, Guam, and the U.S. Virgin Islands: Our estimate of needs for each of these locations is the actual number of units in the PHA or PHAs serving the location multiplied by the national average inspection-based need per unit, multiplied by a local cost adjustment. The total estimate of existing capital needs for the 10,596 units in these PHAs is $233,514,000.

Estimates for lead paint abatement: The source of information for estimating the need for, and costs of lead paint abatement is the PHA survey. The survey respondents are not necessarily a representative sample, and the responses have not been independently verified, thus the estimates are not as reliable as the estimates of inspection-based needs and should be viewed with caution. Although it was expected that all PHAs would have completed lead abatement, the PHA survey indicates that lead paint abatement is still needed in a portion of the stock. Ninety-three PHA survey respondents answered the survey questions regarding lead paint abatement. Their responses indicate that currently only about 5.8 percent of the stock (62,000 units) needs abatement, and the average cost of recent removal has been about $5,000 per unit. Thus, the total national cost of lead abatement is estimated to be $306,788,000.[21]

Estimates for accommodating persons with disabilities: These costs vary significantly depending on the specific conditions of the unit and on other work being conducted. Our key source of information for estimating the costs associated with complying with the Uniform Federal Accessibility Standards (UFAS) was the PHA survey. As noted above regarding the lead paint abatement estimates, these estimates should be viewed with caution. PHAs are required to have at least 5 percent of their stock accessible to people with disabilities.[22] The PHA survey indicates that currently about half of PHAs have at least five percent accessible units, and the other half need to make about two percent of their units accessible, so only about one percent of the public housing stock needs to be modified, or 10,684 units. The average cost reported by PHAs was about $25,000 per unit. Therefore, the estimated total national cost is $264,473,000.

An alternative estimate of the cost of complying with UFAS is the cost of replacing all systems in the kitchen and bathroom of a prototypical public housing unit. To determine the predominant material type and size for each system, we used information collected during the inspections. Our calculation indicates that the average cost for upgrading all systems in a prototypical kitchen and bathroom is $16,601, which leads to a total national cost of $177,365,000 (assuming 10,684 units would require modification).

Estimates for improving energy and water efficiency: As with other costs, the costs for improving energy and water efficiency vary greatly depending on the particular circumstances of the unit and the building; the estimates provided in this study for these energy- and water-related improvements were calculated using the same inspection and cost data sources as the inspection-based estimates of need. (The methodology is different from the other add-on estimates which used PHA input on needs. The

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[21] The study does not include estimates for removal of other hazards such as asbestos.

[22] The requirement is for PHAs to have at least 5 percent of units accessible, but the actual number must be based on the PHA's assessment of need and could be higher. Thus, our estimates provide a lower bound on the number of units that need modifications.

energy estimate is based on a model that assesses payback resulting from incremental upgrades and early replacement of systems).

Many of the technologies that would be replaced for basic livability needs may also lead to better energy and water performance by default simply because of newer product standards that require higher efficiencies compared to the original technologies in the units. Yet, in contrast to other modernization costs, more aggressive improvements could result in even more savings in the form of reduced utility cost—thereby making them desirable for reasons beyond restoring the housing to good working condition.

In order to provide an estimate of the modernization costs needed to improve these efficiencies beyond the already anticipated modernization costs, we included in the study team Steven Winter Associates, a firm that specializes in developing multifamily energy and water (or “green”) rehabilitation projects. Staff from Steven Winter Associates developed a capital cost calculator to model the appropriate improvements to make for each sample development. The cost calculator takes into account development characteristics such as energy usage, fuel types, lighting types, ages of particular systems (windows, appliances, etc.), and development location, along with national cost and utility price estimates to determine possible savings associated with various improvements. The capital costs presented in Exhibit 3-13 assume all improvements are made that would have payback in less than 12 years (described in this study as “moderate” improvements). That is a generally accepted timeframe for HUD-assisted properties. The 12-year “moderate” simple payback criteria leads to an estimated total cost of $4,149,439,000 as shown in Exhibit 3-13.

An additional analysis was performed to look at a more aggressive payback time frame of 20 years as well. Allowing a 20-year payback generates a broader group of improvements, albeit less immediately cost-effective ones. The estimated total cost of improvements that meet this 20-year simple payback criterion is $6,410,483,000.

The capital cost estimate includes both early retirement of functioning equipment and components, as well as replacement at the end of useful life. If the inspection revealed that a particular component was already at the end of its useful life (which is defined as needing replacement in the next five years), the full cost to replace the component was not used in the payback evaluation, but rather only the incremental cost to upgrade to a higher efficiency alternative was used. Likewise, the energy savings associated with the upgrade were calculated relative to current standards of efficiency, rather than the efficiency of the equipment that is being replaced. If the analysis resulted in a payback less than 12 years, it was included in the capital cost estimate. The full cost is not reported since it is assumed that the standard replacement cost has already been accounted for in operating budgets. Early retirement was evaluated for all equipment and components with more than 5 years of remaining life. In these analyses, the full cost to replace the equipment or component was used in payback calculations, and the energy savings were compared to existing performance. If early retirement analyses were deemed cost-effective (payback less than 12 years), they were included in the capital cost estimate.

While the incremental cost of these energy and water improvements are included in the total backlog estimate, it is important to understand that the analyses were not based on energy audits (the preferred method) and that simple payback analysis alone cannot indicate whether it is appropriate to expend funds on such improvements.

These and the other assumptions made in the energy calculator's design are further explained in Appendix D.

Exhibit 3-14 presents the cost drivers for the energy- and water-efficiency upgrades. It shows the ranking of the key contributors to the overall upgrade costs. Exhibit 3-15 depicts the percentage of buildings that would benefit from each kind of upgrade.

- The largest cost driver for energy and water efficiency upgrades is wall insulation, accounting for 22 percent of all costs.
- Attic insulation is the second highest driver, accounting for 13 percent of costs.
- Although new shower heads, unit CFL lighting, and lavatory sinks each contribute less than 1 percent of all upgrade costs, all sample buildings would benefit from these upgrades.
- Similarly, photocell common lighting contributes only about half a percent of costs, but three quarters of buildings would benefit from this upgrade.
- About 60 percent of buildings would benefit from attic insulation, and 40 percent from wall insulation – the two largest cost drivers.

Exhibit 3-14. Cost Drivers for Energy- and Water-Efficiency Upgrades

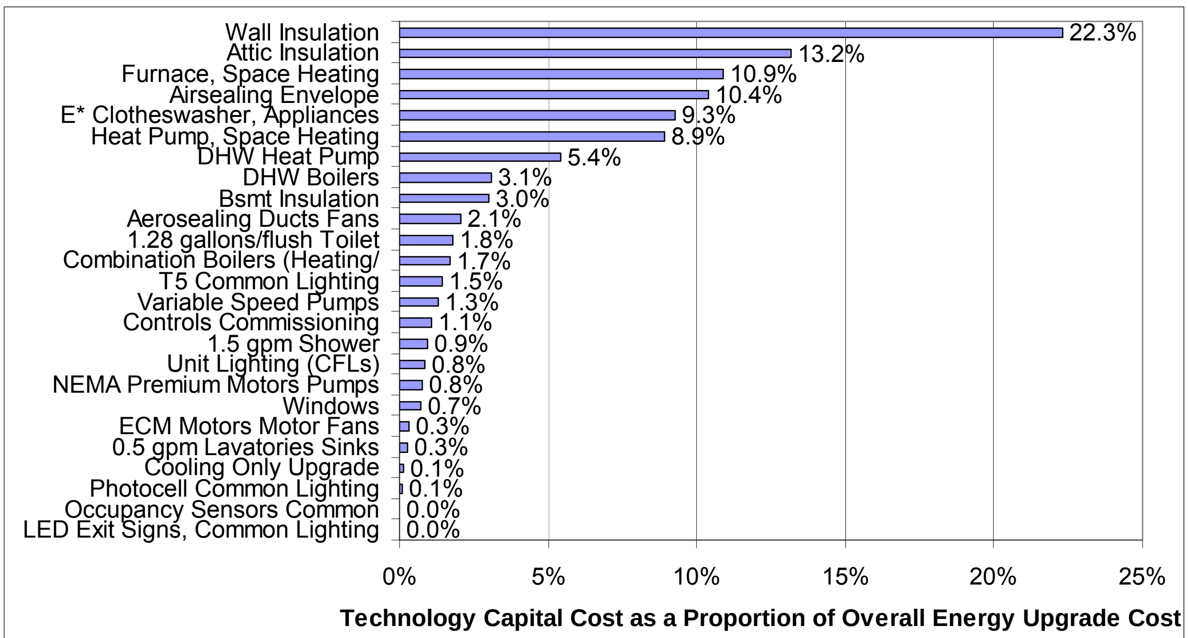
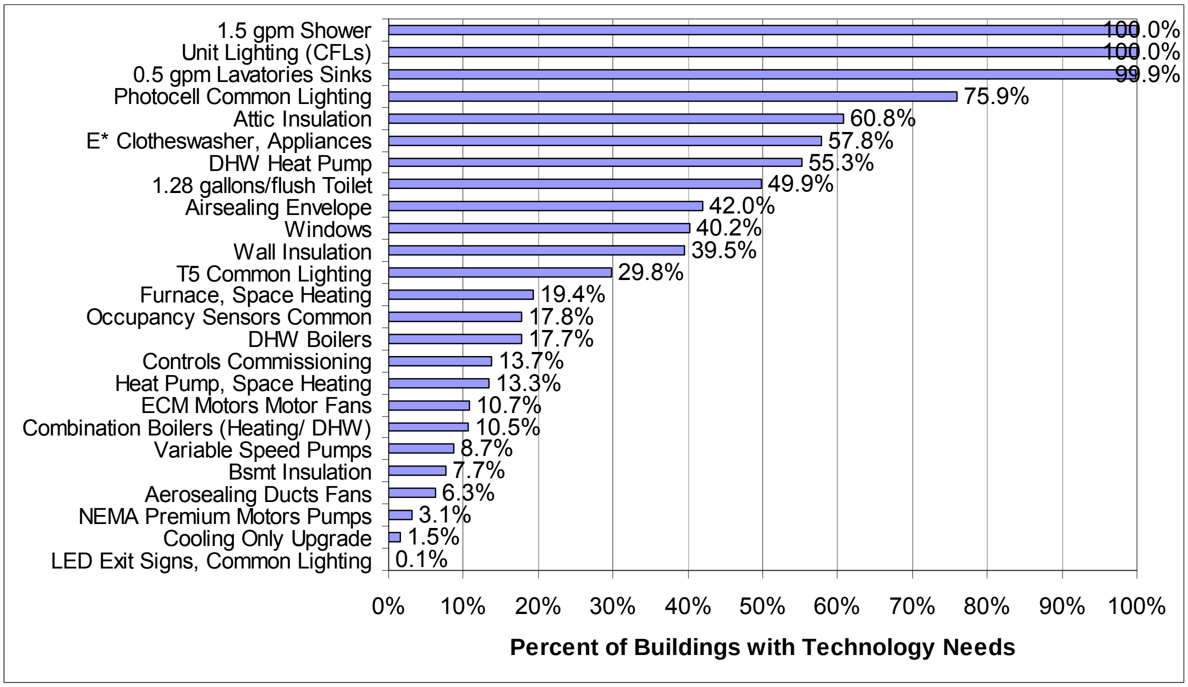


Exhibit 3-15. Percent of Sample Buildings that Would Benefit from Specific Energy- and Water-Efficiency Upgrades



As the calculator is not capable of conducting whole building energy simulations equivalent to modeling software, there are limitations. Some, but not all, interactions between measures is accounted for. For example, the payback for a high-efficiency furnace in a unit that is poorly air-sealed, will be different than the payback following air-sealing. Logic in the calculator accounts for this particular interaction, reducing the heating energy consumed based on improvements on air-sealing and then calculating the savings achieved with a high-efficiency furnace. However, the impact of reducing the lighting load on the heating load is not accounted for. Since the goal of the calculator was an overall cost estimate for the population of buildings, it will be during the implementation phase when individual buildings are evaluated for energy retrofits that the interactions must be addressed and appropriate packages of measures installed. A package of measures that is cost-effective for one building, may not be for another, so it must be understood that positive payback does not necessarily translate into work that should be undertaken for any individual building. Similarly, measures should not be selected independently simply based on their payback, but according to an established hierarchy (ex. furnace replacements should not be selected without air-sealing and duct-sealing).

Further details on the calculator are presented in Appendix D.

3.4. Costs Not Included in the Total National Estimate

Upgrades and Reconfigurations

Using the inspections to estimate the portion of the stock that needs to be upgraded and/or reconfigured were beyond the scope of this study. In order to get some indication of the need for reconfiguration, the PHA survey asked respondents to indicate the percentage of family and elderly units that were marketable in their current configuration. The 100 responding PHAs indicated that approximately 95 percent of both family and elderly units are marketable in their current configurations. The wording of the survey defined "marketable" as currently rented or rentable.

PHAs may make a variety of choices about upgrading public housing developments that may include reconfiguring units, reducing or expanding the size of the development, or changing the market (the income levels or types of household) to which portions of the development are targeted. Creating national estimates for the costs of such a diverse set of real estate decisions would be very difficult. Following are some examples that illustrate the scope of recent projects undertaken by some of the PHAs that responded to the survey. We conducted follow-up interviews with a small number of PHAs that indicated on the survey that they had conducted recent upgrades and/or reconfigurations to meet market needs.

A large PHA in the Midwest recently began the process of upgrading one of its family developments. The project, funded by its Capital Fund and Low Income Housing Tax Credits, will cost approximately $73 million. A total of 726 units will be demolished and replaced by 323 public housing and 410 mixed-finance units. The project began in May 2010. The first phase of the project, consisting of 323 new public housing units, is expected to be completed by early 2012.

The project was undertaken because the development, initially constructed in the 1950s and last upgraded in the 1980s, was considered beyond its useful life. With bedrooms and baths on the second floor, the development had no accessible units. The infrastructure, including electrical systems, was outdated and inadequate and was energy inefficient.

Another large PHA in the Midwest recently undertook a large project to modernize the interiors of 484 of its family townhome units. The development, built in 1952, required significant site and unit modernization to remain viable because it was outdated relative to other available housing in the area. The project began in 2001 and involves five development phases. Phases I through IV were completed by 2009 and resulted in the modernization of 334 units, of which five percent of the units were made accessible. The initial estimated cost of the entire project was $35 million. However the cost of just the first four phases reached $34 million or an average of $101,796 per unit. The first four phases were funded through the agency's Capital Fund. The fifth phase, to complete the final 150 units, will be funded through the American Reinvestment and Recovery Act of 2009 (ARRA) formula funding.

A large PHA in the South recently upgraded 680 family and elderly units within 100 different developments to make them more marketable. The PHA had been experiencing vacancies in more than 10 percent of its units due to their poor condition. The work began in fiscal year 2008 and was completed in fiscal year 2010. The total cost of the upgrades exceeded $7 million, or an average of

$10,353 a unit. This was an increase of $2 million from the original cost estimate. All upgrades were paid out of the agency's Capital Fund.

A medium-sized PHA in the South recently completed renovations to the building exterior and parking lot at a 199-unit high-rise elderly public housing development. Renovations included increasing the number of parking spots for residents and relocating the main entrance. The work began in 2005 and took about a year to complete. The actual cost was $5.9 million, an increase over the original estimate of $5 million, and was paid out of the agency's Capital Fund.

Chapter Four. Change in Capital Needs Between 1998 and 2010

One goal of the study is to estimate the changes in capital needs between 1998 and 2010 and to explain the reasons for the differences. This chapter presents our analysis of changes in needs, both for existing capital needs and for the estimated future accrual of needs.

To make the estimates comparable across the two periods, we made the following two adjustments to the 1998 estimates:

- First, we converted all 1998 estimates to current dollars to facilitate direct comparison, using the Consumer Price Index (CPI) cost-of-living adjustment factor. The CPI increased by 34 percent between 1998 and 2010.
- Next, because the markups applied to direct costs to account for indirect costs such as profit and project management were different for the two studies, we further inflated the 1998 numbers. In 1998 the inspection-based costs were increased by 20 percent to account for profit and overhead and general conditions and by 17 percent to account for PHA management costs and soft costs. In 2010 the markups were 10 percent for general conditions, 15 percent for overhead and profit, 4 percent for contingencies, and 17 percent for PHA management costs and soft costs. Therefore, 1998 costs were multiplied by 1.096 to make them comparable to 2010 costs.

Exhibit 4-1 presents a simple comparison of the estimates of existing capital needs and accrual needs for the stock as a whole for the two periods. The estimated existing capital need decreased from about $36 billion in 1998 to about $26 billion in 2010. Part of this decrease reflects 9 percent fewer units in 2010, but the average backlog amount per unit also decreased, from just over $30,000 per unit to less than $24,000 per unit. If all that had happened was a decrease in the number of units, total existing capital need in 2010 would be about $32.5 billion.

- The inspection-based portion of existing needs decreased by about 38 percent, from about $33 billion to about $21 billion, due in part to a smaller stock (9 percent decrease) and in part to lower needs per unit (31 percent decrease).
- Comparing the non-inspection-based (or add-on) components of the estimates of capital needs is challenging, as the estimation methods for those quantities have changed between the 1998 and current studies.
- The estimate of capital needs for abating lead paint decreased from about $1.5 billion to $300 million, largely because the number of units that still need abatement has decreased over the period. However the methodology for collecting data also changed. In 1998 HUD provided an estimate that 430,000 units (33 percent of the stock) needed abatement at a cost of $2,600 per unit (in 1998 dollars or $3,484 in 2010 dollars). In 2010 the source of data was the PHA survey. The PHA survey indicated that in 2010 only about 6 percent of the stock (62,000 units) needed abatement, and the average cost is about $5,000 per unit.

- The estimate for accommodating persons with disabilities decreased since 1998. Progress appears to have been made in increasing the number of units that comply with Uniform Federal Accessibility Standards (UFAS). Based on the PHA survey, only about one percent of the stock needed upgrades in 2010, at a cost of approximately $25,000 per unit. The total cost for this is about $260 million. 1998 estimates, provided by HUD, were that 3 percent of the stock needed upgrades at a cost of approximately $10,000 per unit (in 1998 dollars, or $13,400 in 2010 dollars).
- The 2010 estimate of capital needs for improving energy and water efficiency, at about $4 billion, is substantially higher than the 1998 estimate of $485 million. This is largely due to a different and improved methodology used for the 2010 estimate. In order to provide an estimate of the costs needed to improve energy and water efficiency, we developed a capital cost calculator to model the appropriate improvements to make for each sample development. The cost calculator takes into account development characteristics such as energy usage, fuel types, lighting types, ages of particular systems (windows, appliances, etc.), and development location, along with national estimates for possible savings associated with various improvements.

Exhibit 4-1. Comparison of 1998 and 2010 Costs

	1998 raw	1998 Adjusted (2010 $)	2010 Adjusted	Percent Change
Number of Units	1,194,370	1,194,370	1,085,407	Decreased by 9%. (Number excludes units approved for demolition/HOPE VI and units in AK, HI, Guam and USVA, but includes scattered sites)
Inspection-based Existing Need	$22,510,291,000	$33,059,514,000	$20,653,780,000	Decreased by 38%. (Party due to 9% smaller stock and partly due to 31% decrease in per unit needs)
Per Unit – Inspection-Based Existing Needs	$18,847	$27,679	$19,029	Decrease of 31%
Additions for AK, HI, Guam and USVA	12,097 units $248,284,000	12,097 units $364,639,000	10,596 units $244,529,000	Decrease of 12% Decrease of 33%
Lead Paint Abatement	$1,118,000,000	$1,498,120,000	$306,788,000	Decrease of 80%
UFAS access	$358,311,000	$480,137,000	$264,473,000	Decrease of 45%
Energy conservation	$361,935,000	$484,992,000	$4,149,439,000	Increase of 756%
Total National Existing (Backlog) Need	$24,596,821,000	$35,887,403,000	$25,619,009,000	Decrease of 29%
Per Unit	$20,387	$30,047	$23,375	Decrease of 22%
Average Annual Accrual per Unit[23]	$1,679	$2,466	$3,155	Increase of 28%

1998 numbers are adjusted as follows:

Multiplied * 1.34 for inflation
To make markups comparable, multiplied * 1.096 (old mark up 20%, current 31.6%)
In 1998 used 20% for general conditions, overhead and profit
In 2010 used 10% for general conditions, 15% for overhead and profit, and 4% for contingency

[23] Accrual estimates are for the inspection universe only, and only cover items included in the inspection-based estimates of need.

4.1. Reasons for Changes in the Estimate of Existing Needs between 1998 and 2010

Three types of reasons are behind the changes between the 1998 estimate and the 2010 estimate. Differences could reflect changes in the public housing stock, differences in methodology between the two studies, or changes in the real, inflation-adjusted costs of making repairs and replacements.

Changes in the Public Housing Stock, 1998-2010

Some of the existing capital needs as of 1998 have been met as of 2010. Capital Fund dollars have been expended, in some cases improving entire properties, and in other cases improving specific systems and system components within properties. Outside of the Capital Fund,[24] significant amounts of HOPE VI dollars also have been spent on units that were part of the study universe. We removed from the study universe properties that had approved HOPE VI implementation grants as of June 2008, but kept in the sample universe public housing units for which renovations funded by HOPE VI (sometimes using other sources of financing as well) were complete, although by chance none of these properties turned up in the sample. The PHA survey indicates that about 28 percent of survey respondents have taken advantage of the Capital Fund Finance Program (CFFP) to obtain additional funds to finance capital improvements, although the estimate does not necessarily represent the overall public housing stock. Repairs and replacements made over the 1998-2010 time period may have exceeded accruing needs and reduced the backlog of capital needs.

The public housing universe has changed in other ways since 1998. Some of the properties that had the highest needs in 1998 have been demolished. Properties with approved demolition plans as of 2008 were excluded from the study universe, as were properties that had left the stock already. Altogether, we estimated that 98,940 units had been removed from the public housing stock or were slated for demolition by the time we did the inspections in 2010. Many of these units were still in the public housing stock as of 1998 and would have been among the highest needs units for which that study measured existing needs.

Differences in Methods between the Two Studies

The calculation of existing capital needs changed somewhat between the two studies:

- The methodology for treating over-age systems changed between the 1998 and 2010 studies to reflect a more realistic approach. In 1998 we assumed that all over-age systems would be repaired or replaced as part of meeting existing needs. The approach used in the current study allows for some over-age systems to remain in place if they are still in working condition and to be replaced at their expected failure time. Inspectors used their judgment and experience to assign a remaining useful life to all observed

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[24] In addition to annual allocations from the Capital Fund, the American Reinvestment and Recovery Act of 2009 (ARRA) provided an additional $4 billion in funding for the Capital Fund. The ARRA funding was allocated during the study's inspection period, but generally projects were not yet underway at the time of the inspections.

systems that could be longer or shorter than the expected useful life from standard tables. As shown below, this assumption had substantial impacts on the 2010 estimates.

- The structure of the markups used to reflect the indirect costs of real estate development changed between the two studies. In 1998, based on standard practice at the time, we marked up all costs by 20 percent for a combination of overhead, profit, and general conditions. They were further marked up by 17 percent for PHA management of the modernization effort and soft costs. Based on prevailing practice in 2010, we used a 10 percent markup for general conditions, 15 percent for overhead and profit, and 4 percent for contingencies. As in 1998, costs were further marked up by 17 percent for PHA management of the modernization effort and soft costs.

  The comparison of 1998 and 2010 needs shown on Exhibit 4-1 already takes this difference into account. 1998 costs are inflated by the difference between the two sets of markups for indirect costs. As shown below, using the 1998 inflators for both years, instead of the 2010 inflators would yield lower numbers overall, but the same percentage change.

- We added about 60 systems to the inspection protocols in 2010 that were not in the protocols used in 1998. During the process of reviewing and improving the inspection protocols, we added several dozen systems, including sprinkler heads, bulkheads, elevator controls/dispatch, boiler temperature controls, site water towers, site gas, electric mains, railings (balcony, hall, and stair), vents and exhausts (bathroom), grab bars (bathroom), HID lighting, and storm windows. As part of the improvement of the inspection system, we also added multiple material types for many systems, so that in all over 700 items were costed in 2010, compared with about 165 in 1998.

- In 1998, the study had a concept of "modest upgrades" when needed. This would mean adding systems if they were absent but the inspector felt they were needed in order to provide housing that is consistent with the neighborhood. Key examples of these types of upgrades were adding parking or air conditioning. The current system focuses only on systems that are present and observed. However, complete upgrade packages are assigned to kitchens or bathrooms (replacing all systems) when three or more systems in the room need replacing.

Real Changes in the Cost of Repairs and Replacements

- To examine the changes in costs over time, inflation has to be taken into account. The choice of inflation indexes has a significant impact on the results. In adjusting the 1998 costs to be comparable to the 2010 costs, we used the CPI inflation adjustment of 34 percent. However, that is not necessarily the correct adjustment factor. Construction-related costs may have escalated at a different rate from the general CPI. For example, the RSMeans construction cost index increased by 59 percent during the period 1998 to 2010, and the cost estimator for the study A.M. Fogarty and Associates indicated that in their experience construction costs rose even more. After considering alternatives, we decided to use the CPI to adjust 1998 costs to make them comparable to 2010 costs to be consistent with the methodology used in 1998 and because it reflects a wider range of costs, besides the direct costs of construction, that must be included in meeting capital needs. However, a case can be made for other inflation adjustment factors. Because the inflation factor plays such an important role in determining the degree of progress achieved since the last study, additional work on identifying a more precise measure might be warranted.

- The repair or replacement costs for some items have changed relatively more than others, and changes (both increases and decreases) to real costs may not be reflected fully in the inflation factor that we used to adjust 1998 estimates to 2010 dollars. Some industry standards applied by the inspectors and by the cost estimation file have changed over the past ten years. For example, it is now standard to provide energy efficient appliances, which may have different costs from older standard appliances. At the same time, the real costs of some items may have dropped over this period.
- We tried to compare the 1998 and 2010 costs for the 20 systems that contribute most to capital needs. The comparison is often difficult to carry out, because the inspection protocols for 2010 provided significantly more detail on system possibilities compared with 1998. For example, in 1998 inspectors could check off three types of fences based on materials (chain link, wrought iron, and stockade). The current system allows for 15 choices for fencing (5 types and three sizes for each type). Thus, it is difficult to make direct comparisons. Depending on the size and materials of the fence, the cost for fencing has gone up, the cost has gone down, or there was no comparable choice in 1998. Following are some examples of changes in costs for the systems that are key cost drivers.
  - Although the system allowed for 15 different types of fences, more than half were either under 4 feet or 4 to 8 foot chain link fences. Assuming a 34 percent inflation factor from 1998, the cost for low fences decreased by 30 percent in real terms, while for 4 to 8 foot fences costs stayed the same.
  - The 2010 system allowed for three types of sidewalks, but the vast majority were paved concrete. The 1998 system only provided costs for "paved pedestrian areas" without detailing materials. Assuming that these were also concrete, the cost increased by 43 percent in real terms under a 34 percent inflation scenario.
  - Site water lines, water mains and sanitary lines all increased modestly in real terms.
  - The cost of unit entry doors stayed the same in real terms, while the real cost of interior doors and closet doors decreased substantially.
  - Costs for exterior walls decreased in real terms since 1998, as did the cost of replacing exterior lighting.
  - Real costs for replacing roof systems such as chimneys, hatches and skylights, and penthouses all increased substantially, including a doubling of costs for replacing penthouses.
  - In 1998 costs were provided for three window types based on size (small, medium and large). The 2010 system priced more than 15 types of windows, based on materials (aluminum, vinyl, wood) and type (single hung, double hung, sliding, casement etc). The majority were various types of aluminum windows. Compared with the cost of a medium sized window in 1998, window costs generally increased slightly between 1998 and 2010 in real terms. However, costs nearly doubled for a small window and decreased slightly for the cost of a large window.
  - Floor finish costs generally increased in real terms.

- Costs for replacing kitchen and bath systems did not change very much. For example, costs for some systems such as kitchen cabinets, stoves, and vanities increased slightly, while the costs of replacing refrigerators and bathtubs decreased slightly.
- Costs for unit thermostats increased substantially—the 2010 costs are 4 to 5 times the 1998 costs in real terms.
- Costs for domestic hot water generation systems also increased.

4.2. Comparisons of 1998 and 2010 Inspection-Based Needs under Different Scenarios

Exhibit 4-2 compares 1998 costs and 2010 inspection-based needs under several alternative scenarios that try to make the comparisons as similar as possible. The goal of the exhibit is to try to isolate the effect of true changes in the condition of the stock from changes in the estimates that result from differences in the methodologies used and from differences in some of the assumptions used to generate cost estimates for 2010 and 1998. As the exhibit shows, the estimate of change is highly dependent on the assumptions and methodologies used. In particular, a key driver in the estimated decrease in needs between 1998 and 2010 is the treatment of over-age systems. In 1998 we assumed that all over-age systems were repaired as part of addressing existing needs, and in 2010 we adopted a more realistic assumption of only replacing systems that have worn out rather than replacing all over-age systems. As shown in the scenarios below, some changes to the estimation methodology to make the two approaches more similar lead to increases in the estimated differences over time (for example eliminating costs of systems that were not inspected in 1998), while other changes decrease the difference (notably assuming that in 2010 all over-age systems are replaced). [25]

The inflation factor used to inflate 1998 costs to 2010 dollars also has a significant impact on the estimate of change. Assuming a higher inflation rate since 1998 leads to a larger estimate of the decrease in capital needs over the period.

- **Base scenario.** The base scenario, presented in Exhibit 4-1 and repeated here, uses the 2010 indirect cost markup structure for both 2010 and 1998 costs, and a 34 percent inflation factor for 1998 estimates, but keeps the different approaches for treating replacement of over-age systems (replacing all over-age systems in 1998, but replacing only systems deemed needing replacement by the inspector in 2010), and keeps in the repair costs for the full set of systems inspected in each year. Under the base scenario, our estimate of inspection-based needs decreased by about 37 percent for the stock as a whole from $33 billion in 1998 (expressed in 2010 dollars) to about $20.7 billion in 2010. This reflects an estimated decrease of about 9 percent in the number of units, and a decrease of approximately 31 percent in the needs per unit.

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[25] We were not able to make any adjustments to account for the third major difference between 1998 and 2010 – the difference in the concept of upgrades. In 1998 inspectors noted when systems needed to be added or upgraded in order to make the property more marketable to low-income households, while in 2010 upgrades were assumed for system groups if more than 3 components needed replacement.

- **1998 mark-ups**. This scenario applies the lower 1998 indirect cost mark up structure to both the 1998 and 2010 costs, assumes a 34 percent inflation factor, retains the different approaches to treating replacement of over-age systems, and keeps in the repair costs for the full set of systems inspected in each year. Applying the lower 1998 mark up structures would yield a total estimate of $18.8 billion in inspection-based needs 2010 compared with $30 billion in 1998. As in the base case, this estimate is 37 percent lower than the 1998 estimate, since the same markup structure is assumed in both periods.

- **Higher cost inflator.** The base scenario used the CPI inflation rate of 34 percent. However, if we assume a higher cost inflator for the 1998 costs, for example the RS Means inflator of 59 percent, then the estimate of inspection-based needs in 1998 increases to $39 billion (in 2010 dollars), instead of $33 billion under the lower inflation scenario. Since the 1998 estimate is higher, the decrease in the estimate of needs between 1998 and 2010 is even greater under this scenario: 47 percent for the stock as a whole, and 42 percent on a per unit basis.

- **1998 assumption regarding over-age systems**. This scenario uses the 2010 markup structure for both 1998 and 2010 estimates, uses a 34 percent inflation factor to adjust 1998 data, and keeps in the repair costs for the full set of systems inspected in each year. But we apply the 1998 assumption regarding replacement of all overage systems to the 2010 inspections: in other words, as in 1998, we assume that all overage systems are replaced as part of the existing needs, regardless of observed condition. Under this scenario, many more systems would be replaced earlier. The estimate of inspection-based needs for the stock in 2010 would be $32 billion rather than $21 billion, a decrease of only 3 percent relative to 1998. While the overall estimate for the stock still decreases, the per unit estimate of needs actually increases by about 6 percent relative to 1998. The decrease in the total cost results entirely from the smaller stock.

  Using the same 1998 study method to treat over-age systems, the 2010 estimate of average annual accrual needs would be $2,829 (instead of $3,155) per unit. The estimate of accruals decreases under this scenario because many systems that would have been replaced during the accrual period would now be replaced as part of addressing existing needs.

- **Exclude items in new system categories**. As discussed earlier, the 2010 inspection system included repair needs estimates for approximately 65 systems for which no categories were available in 1998. This scenario uses the 2010 markup structure and the 34 percent inflation factor to make 1998 estimates more comparable to the 2010 numbers, but keeps the different approaches for replacement of over-age systems. However, we make the two inspection protocols more comparable by excluding the additional systems that were added in 2010. This reduces the 2010 inspection-based needs estimate by about 6 percent--from $20.7 billion to $19.3 billion. The $19.3 billion is 42 percent lower than the 1998 estimate.[26]

- **1998 assumption regarding overage systems and exclude items in new system categories.** Finally, in order to make the two estimates as similar as possible, this

[26] Some specific systems were grouped together in 1998 that are now identified separately and vice-versa.

scenario both applies the 1998 approach to replacing overage systems and excludes new systems. The resulting estimate of inspection-based existing need is $29 billion in 2010 (compared with a base scenario of $21 billion), and represents a decrease of 13 percent relative to 1998. The estimate of needs per unit stays nearly flat, declining from about $28,000 to $27,000. The decrease in the total estimate of inspection-based needs is almost completely attributable to the smaller size of the public housing stock. If we apply a higher inflation factor to 1998 numbers under this scenario, the estimate of inspection-based need would decrease even further for the stock between the two periods, and the per unit decrease would be larger as well.

Exhibit 4-2. Alternative Scenarios for Comparing Inspection Based Needs in 1998 and 2010

	1998 raw	1998 Adjusted (2010 $)	2010 Adjusted	Change between 1998 and 2010
Number of Units	1,194,370	1,194,370	1,085,407	Number of units decreased by 9%. (Number excludes units approved for demolition/HOPE VI and units in AK, HI, Guam and USVA, but includes scattered sites)
<u>Base Scenario</u> Assumes 2010 mark up 1998 numbers multiplied by 1.34 for inflation and by 1.096 to account for higher 2010 markups	$22,510,291,000	$33,059,514,000	$20,653,780,000	Decreased by 38%. Partly due to 9% smaller stock and partly due to 31% decrease in per unit needs (includes estimates for scattered sites, excludes AK, HI, Guam and USVI)
Per Unit	$18,847	$27,679	$19,029	Decrease of 31% relative to 1998
<u>Assumes 1998 mark-up</u> (1998 number multiplied by 1.34 for inflation, 2010 numbers multiplied by 0.863 to reflect 1998 mark up	$22,510,291, 000	$30,163,790, 000	$18,838,960, 000	Decreased by 38%. Partly due to 9% smaller stock and partly due to 31% decrease in per unit needs (includes estimates for scattered sites, excludes AK, HI, Guam and USVI)
Per Unit	$18,847	$25,255	$17,357	Decrease of 31% relative to 1998
<u>Assumes higher inflation between 1998 and 2010</u> Assumes 2010 mark up structure, and 59% inflation factor	$22,510,291, 000	$39,227,334, 000	$20,653,780,000	Decreased by 48%. Partly due to 9% smaller stock and partly due to 42.1% decrease in per unit needs (includes estimates for scattered sites, excludes AK, HI, Guam and USVI)
Per Unit	$18,847	$32,844	$19,029	Decrease of 42% relative to 1998
<u>Uses 1998 remaining useful life approach</u> Assumes 2010 mark up structure, and 34% inflation Assumes 2010 uses 1998 remaining useful life approach (replace all over-age systems)	$22,510,291, 000	$33,059,514, 000	$31,933,380, 000	Decreased by 3 %. Partly due to 9% smaller stock and partly due to 6 % decrease in per unit needs (includes estimates for scattered sites, excludes AK, HI, Guam and USVI)
Per Unit	$18,847	$27,679	$29,421	Increase of 6.% relative to 1998
<u>Excludes items in new system categories</u> Assumes 2010 mark up structure, and 34% inflation Assumes 2010 inspections exclude all items in system categories that did not exist in 1998	$22,510,291, 000	$33,059,514, 000	$19,324,111,000	Decreased by 42%. Partly due to 9% smaller stock and partly due to 36 % decrease in per unit needs (includes estimates for scattered sites, excludes AK, HI, Guam and USVI)
Per Unit	$18,847	$27,679	$17,804	Decrease of 36% relative to 1998
<u>Using 1998 remaining life approach and excluding items in new system categories</u> Assumes 2010 mark up structure, and 34% inflation Assumes 2010 uses 1998 remaining useful life approach (replace all over-age systems) and excludes items in new system categories	$22,510,291, 000	$33,059,514, 000	$28,858,344, 000	Decreased by 13%. Partly due to 9% smaller stock and partly due to 4 % decrease in per unit needs (includes estimates for scattered sites, excludes AK, HI, Guam and USVI)
Per Unit	$18,847	$27,679	$26,588	Decrease of 4% relative to 1998

Chapter Five. Other Research Goals

This chapter addresses the study's other research goals:

1. Assess whether the current REAC inspection system can provide useful estimates of capital need;
2. Describe the way in which PHAs are now estimating existing capital needs; and
3. Assess the impact of conversion to asset-based management, including the consolidation of developments into asset-management projects (AMPs), on estimating capital needs.

5.1. Assess Whether Current REAC Inspections Can Provide Useful Estimates of Capital Needs

As part of HUD's mission to ensure that public housing units provide decent, safe, and sanitary housing to their occupants, HUD conducts physical inspections through the Real Estate Assessment Center (REAC) and generates a PASS (physical assessment subsystem) score. Since REAC inspections generally are conducted annually or biennially at all properties, HUD is interested in determining whether REAC inspections might be used to generate estimates of capital needs on an ongoing basis.

REAC Inspection Process

REAC inspectors cover five inspection areas (site, building exteriors and roofs, building mechanical and engineering systems, common areas, and dwelling units) and record deficiencies in specific systems in these areas (such as fencing and gates within the "site" area and bathroom cabinets in the "unit" area). As part of the REAC inspector's site visit, all buildings and a sample of units are inspected.[27]

Scores are generated based on the criticality and severity of any observed deficiencies and on whether the observed deficiency includes a life threatening or non-life threatening health or safety problem For example, within the bathroom inspection, clogged drains are at the highest criticality level of "5," whereas damaged or missing bathroom cabinets are at a lower criticality level of "2." More points are deducted for more critical systems and for more severe deficiencies. For example, within the clogged drain deficiency, a less severe level "1" deficiency refers to a sink where water does not drain freely but can be used, while a more severe level "3" deficiency refers to an unusable fixture because the drain is completely clogged or deteriorated. The inspectors focus on whether a component is functioning properly on the day of the inspection, not necessarily taking into account whether that component or system has an extended period of useful life.

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[27] The sample size depends on the number of units in the property, where the percentage of units inspected is larger in small properties.

The REAC inspection process does not include “counts” or “take-offs/measurements” of site and building systems, with the exception of acquiring a total square footage of “Site Paving” (sidewalk and parking lot square footage) for the inspected development. The deficiencies are recorded on a hand held computer utilizing HUD/REAC’s computer based compilation program. Scores are then generated by HUD/REAC to grade the development based on the observed deficiencies. This score may be high or low, with no correlation as to whether that same property may be facing significant capital expenditures in the coming years for addressing expected system failures or for items that will exceed their expected useful lives.

Capital Needs Inspection Process

The capital needs inspection process generally covers the same property components as the REAC inspection process. As in the REAC inspection, the capital needs inspector observes a sample of buildings and dwelling units. The inspector records the condition of all systems that impact capital needs—in other words systems, whose repair and replacement would come out of a capital budget, rather than a maintenance budget. In addition to recording the condition of each system, the inspector provides a count (either a number, or a measurement) for each system in the property so that repair/replacement costs can be assigned to the entire property based on the observed sample, and records system age and expected remaining useful life so that accruals of future needs can be estimated.

Comparison of the Two Processes

The information captured from the REAC inspection process and the capital needs inspection process are similar in some respects. The condition of inspected systems is recorded. However, the capital needs inspection procures information about specific building/site systems in more detail than the REAC inspection in various respects, recording numbers/counts, age of systems, type of systems, and measurements. The REAC inspection is designed to be a snapshot of conditions on the day of the inspection, focusing on immediate repair and health/safety concerns that would adversely affect HUD’s mission to ensure that public housing units are decent, safe, and sanitary. As part of the REAC inspection process, inspectors are supposed to focus on whether a component is working/functioning on the day of the inspection and not account for whether that component’s expected useful life will have an impact on the capital funding circumstances of the property moving forward. Under the current REAC inspection system, a property in which many major mechanical and architectural systems are functional today may score well upon inspection, but that same property may incur significant capital expenditures in the coming years to address systems or components of systems that will soon fail or exceed their expected useful life.

The capital needs inspection process records the observed conditions, age, and remaining/expected useful life of systems/components. These observations are then cost-coded, and these results are analyzed to forecast current and future capital expenditures. The inspection protocol focuses on observing systems that contribute to capital needs, not necessarily those items that would generally be handled as maintenance concerns. For example, in the bathroom system, the conditions for sinks note whether the sink is in working order, whether the fittings need to be repaired or replaced, or whether the entire sink needs to be replaced. There is no observation regarding clogged sinks, because repairing a clogged sink would be a maintenance item rather than a capital repair.

Thus, there is no inherent correlation between the REAC scoring system and a capital needs estimation system. The two systems are aimed at measuring different things. REAC focuses on items that may be deemed more "critical" for providing housing that meets health and safety standards. Systems that are critical to providing safe and sanitary housing may or may not require capital repairs. Systems that are "critical" to being addressed (as part of the REAC inspection) may or may not require capital expenditures in order to correct their criticality. While there are some similarities between the two inspection systems, the REAC inspection process and scoring systems would need to be modified *significantly* in order to be used as a tool for generating capital needs estimates in the future.

As part of this study research we conducted a detailed comparison of the data collection instruments used by REAC and the capital needs inspectors to assess whether the REAC deficiency definitions and measurement definitions for key capital needs cost drivers are sufficiently detailed to enable their use in generating condition estimates and quantity estimates that can be used to estimate repair needs. We examined procedural differences such as: differences in the collection of take-off data; differences in the extent of probing by the inspector for information on conditions; differences in the use of judgment; and differences in the number and types of systems observed. Appendix E contains this comparison of the top eighteen cost drivers for existing modernization needs.

In summary, REAC is a snapshot in time and in its current form cannot be compared to a capital needs assessment. REAC identifies problem conditions as deficiencies on a single day, and it does not currently provide the information needed to estimate current capital needs and ongoing accrual costs. In order to be able to use a REAC inspection to estimate capital needs, counts and ages and remaining useful lives of key systems would be needed.

In order to explore this further we could conduct an analysis of the relationship between the REAC scoring for the key capital needs cost drivers (particularly windows, kitchens, and bathrooms). For a sample of properties we could test whether there was any correlation between the recorded REAC conditions scores and the capital needs estimates for these systems. Since these three system groups account for roughly 40 percent of all capital needs, this would provide a preliminary test of the correlation between the two inspection protocols. To test this, we would need to conduct simultaneous REAC and capital needs inspections on a sample of properties. Another approach would be to compare the latest REAC PASS score with the estimate of modernization needs of the sample properties to see if they are correlated in any way.

5.2. Describe the Way in Which PHAs are Now Estimating Needs

Our analysis of the way in which PHAs currently estimate address capital needs relies on the PHA Survey results and on a review of the physical needs assessments conducted by the study PHAs for the sample properties.

As part of the PHA survey, we asked PHAs to describe the process they use to determine how to allocate funds for capital improvements. The responses were provided as open-ended text. PHAs report that they rely on the following information to develop their plans:

- Physical needs assessments;
- Five-year plans;
- Input from agency staff including property managers and maintenance staff;
- Input from residents and others at public hearings;
- REAC inspections regarding immediate health and safety needs;
- Energy audits;
- Emergencies that arise; and
- American Disability Act (ADA) requirements.

Seventy-five responding PHAs (65 percent of the total) indicated that they used the REAC inspection in some way as part of the capital planning process. In general, REAC inspections are used by PHAs in two ways. First, they help identify health and safety issues that become priorities for improvement. Second, a number of PHAs indicated that they prioritize capital improvements that caused the PHA to lose points on a REAC inspection. For example, one PHA noted that in 2008 all sidewalks were repaired or replaced because the PHA had lost REAC points the previous year due to problems with the sidewalks.

PHAs also use physical needs assessments (PNAs) conducted on their developments to help develop their capital plans. PNAs are supposed to identify all the work a PHA needs to undertake to bring its developments up to HUD's modernization and energy conservation standards, to comply with lead-based paint requirements, and to comply with public housing program requirements. In accordance with 24 CFR 968.315, PNAs are completed without regard to the availability of funds. They are supposed to include a brief summary of the physical needs necessary to bring the development up to HUD standards, the replacement needs of equipment systems and structural elements, and a preliminary estimate of the cost to complete the physical work. In practice, the content and quality of PNAs varies a great deal, partly because of outdated regulations.

We asked PHAs to submit copies of their most recent PNAs conducted for the sample of properties. A total of 44 agencies submitted PNAs for some or all sample properties. They represent 38 percent of the agencies that responded to the PHA survey, or 31 percent of the PHAs in the study sample. PNAs are conducted at the development-level. The sample included PNAs for 102 separate developments, or 19 percent of the sampled developments.

Exhibit 5-1 summarizes the information obtained from the PNAs provided by the sample PHAs. PNAs can be conducted either in-house by PHA staff or through an outside contractor. Of the PNAs reviewed, seven percent were done by the PHA itself, 43 percent were completed by a contractor, and 50 percent did not include any information relating to what entity conducted the assessment. The average percent of units inspected for the PNAs was 14 percent.

The quality and detail of the PNAs varied widely by agency. Most PNAs included a preliminary cost estimate of physical work needed either for the entire development or on a per-unit basis. The period of time covered by the PNAs varied considerably. Of the PNAs that included a time period, most identified capital needs for a one- to five-year period from the date of inspection (25 percent of PNAs) or for a full 20 years from the date of inspection (65 percent of PNAs). The average number of years covered by a PNA was 14.6 years.

Although most PNAs included some estimate of the cost of the development's physical needs, only 17 percent of received PNAs were a full inspection report including both detailed cost estimates over a period of time and a narrative specifying the needed physical improvements. Thirty-eight percent of PNAs were detailed cost estimates with no narrative, and 45 percent of the PNAs were only summary documents that did not include detailed cost estimates or narratives. Of those PHAs that submitted only summary documents, 57 percent submitted the one-page HUD Form 52832, Physical Needs Assessment Form. This form is submitted by PHAs with their PHA Plans when pursuing a Capital or Operating Fund Financing Program.

From the PNA narratives and detailed cost estimates provided, we identified the key cost drivers—that is, the needs with the highest cost estimates for improvements. Kitchen renovations were the key cost driver cited most frequently, with 35 percent of PNAs including kitchen upgrades as one of their most expensive needed improvements. Other high cost repairs and upgrades identified by PNAs include roofs (23 percent of PNAs), windows (22 percent), flooring/carpet (22 percent), paint (21 percent), and HVAC (19 percent).[28]

[28] These are generally the same cost drivers found in the study's inspections—kitchens, windows and baths are the key cost drivers, followed by exterior walls and roofs. Our study considered painting a maintenance item.

Exhibit 5-1. Summary of Physical Needs Assessments Received

	No. of PNAs	Percent of PNAs
Percent of Units Inspected		
≤10%	14	14%
11%-15%	3	3%
16-20%	3	3%
Greater than 20%	2	2%
Unknown	80	78%
Total	**102**	**100%**
Number of Years Included in PNA Cost Estimates		
1-5 Years	15	15%
6-10 Years	4	4%
11-15 Years	2	2%
16-20 Years	39	38%
Unknown	42	41%
Total	**102**	**100%**
Year Most Recent PNA Conducted		
2009	28	27%
2008	20	20%
2007	7	7%
2006	13	13%
2005 and Earlier	18	18%
Unknown	16	16%
Total	**102**	**100%**
Inspection Method		
In-house	7	7%
Contractor	44	43%
Unknown	51	50%
Total	**102**	**100%**
Type of PNA Document Submitted		
Summary Document Only	46	45%
HUD Form	26	25%
Other Summary Document	20	20%
Full Report (cost estimates and narrative)	17	17%
5 Year Cost Estimates	2	2%
20 Year Cost Estimates	11	11%
Cost Estimate Time Period Not Defined	4	4%
Cost Estimates Only (no narrative)	39	38%
5 Year Cost Estimates	5	5%
10 Year Cost Estimates*	6	6%
20 Year Cost Estimates	24	24%
Cost Estimate Time Period Not Defined	4	4%
Total	**102**	**100%**
PNA Key Cost Drivers		
Kitchen	36	35%
Roofs	23	23%
Windows	22	22%
Flooring/Carpet	22	22%
Paint	21	21%
HVAC	19	19%
Bathrooms	12	12%
Water/Sewer	11	11%

*Includes reports with nine- to twelve-year cost estimates.

Comparisons with Inspection Results

To examine the relationship between PNAs and inspection-based estimates of capital needs, we focused on a subset of sample developments where we had both the PNA and inspection-based estimates. A total of 66 PNAs had useable estimates of capital needs per unit. The average cost per unit across these PNAs was $30,281, with a median of $27,191. The study mean estimate of inspection-based capital needs for these 66 properties was $25,066 with a median of $20,145.

As expected, there is no correlation between the PHA estimates of capital needs and the inspection results. For the group of properties with estimates of capital needs from PHA-sponsored PNAs, the correlation between the PHA provided estimate and the capital needs estimate is 0.15, indicating low correlation.

There are a number of reasons for the differences in these estimates:

- Our inspections were not geared to generating property-level estimates. For this study, only about 4 units and buildings per property are being inspected. Therefore, we cannot expect to obtain precise estimates at this level.
- Inspections reflect a particular snapshot in time. PNAs provided by the PHAs were often more than 5 years old at the time they were submitted to us. All of this study's inspections were conducted in late 2009 through early 2010. Any observed differences may be the result of differences in actual condition due to timing, a different sample of inspected buildings, units or systems, or subjective differences across inspectors. We cannot distinguish among these sources of difference. We conducted a similar exercise as part of our 1999 evaluation of the portfolio reengineering demonstration.[29] For that project, we conducted independent capital needs assessments for a sample of 15 properties that had been inspected as part of the reengineering process in order to assess the quality of the original inspections. We generally found differences across the two inspections but could not determine whether they were due to timing differences, different protocols used, or inspector judgments.
- The PNAs may include different systems and may use different markup assumptions. The PNAs provided by the PHAs generally do not provide sufficient information to determine what costs and what markup structures are included in the estimates.

5.3. Impact of Conversion to Asset-based Management on Estimating Capital Needs

In 1998, Congress passed the Quality Housing and Work Responsibility Act, which created a new Operating Fund Program for public housing. In 2005, HUD published a Final Rule on the Operating Fund Program that required PHAs of 250 or more units to convert to asset management.

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29 James Wallace et al. *Evaluation of HUD's Portfolio Reengineering Demonstrations*. Final Report (Abt Associates December 1999).

The five essential components of asset management are project-based funding, project-based management, project-based budgeting, project-based accounting, and project-based oversight and performance assessment. Full implementation of asset management for PHAs of 250 or more units is required by fiscal year 2011.

As part of the conversion to asset-based management, many PHAs have consolidated old "developments" into new, larger AMPs (asset-management projects), and in a few cases have separated old "developments" into a number of new AMPs. Overall the trend is toward consolidation: the universe of developments went from about 14,530 in the pre-asset management period to about 7,404 following implementation of asset management.

HUD is interested in the impact, if any, of the transition to asset management on actual capital needs and on PHAs' ability to estimate needs. In order to address these questions, in the survey of sampled PHAs, we asked if PHAs had transitioned to asset management. Of the 116 responding PHAs, 66 percent had transitioned to asset management, 28 percent had not transitioned, and 6 percent did not respond to this question.

PHAs were asked to describe the impact of their transition to asset management on their agency's ability to plan and allocate capital funds. Of the 77 PHAs that had transitioned to asset management, 56 percent reported minimal or no impact, while a few PHAs reported positive or negative impacts (19 percent and 13 percent respectively). Examples of reported positive impacts include improvements in determining the cost of operating individual developments, allocating funds, identifying areas of need, and identifying opportunities for energy savings. Examples of reported negative impacts include an additional administrative burden and more complicated planning and cost control.

Expenditures Related to the Transition to Asset Management

We asked PHAs if they had capital, operational, or management expenditures related to their transition to asset management. Most of the PHAs did not have transition-related capital expenditures. Of the 77 responding PHAs that had transitioned to asset management, only 22 percent had related capital expenditures, 69 percent did not, 8 percent did not know, and 1 percent did not respond. However, about half of the PHAs did have transition-related operational or management expenditures. The most common examples of transition related expenditures were computer software and hardware, equipment, office space renovations, and staff training.

Chapter 6. Conclusion

This report presents estimates of the existing capital needs of the public housing stock as of 2010, and estimates of annual accruals of new needs for the next 20 years assuming that all existing needs are met. A similar report was prepared for HUD regarding the status of the stock in 1998. The new 2010 estimates are not directly comparable to the 1998 estimates appearing in the earlier report. They present a more realistic picture of capital needs because they take into account the actual remaining useful life of systems and also reflect current practices for markups for indirect cost.

While the inspection-based needs are based on a proven methodology, some care must be used in interpreting the other categories of capital needs that were estimated independently. The additions for lead paint abatement and accessibility improvements are based on needs identified by a sample of PHAs, rather than by direct observation, and the PHAs that responded to the relevant survey questions are not necessarily a representative group. The total existing need of $25.6 billion includes $4.1 billion for energy and water efficiency improvements that can be justified on the basis of simple payback analyses. While the incremental cost of these green improvements are included in the total backlog estimate, it is important to understand that the analyses were not based on energy audits (the preferred method) and that simple payback analysis alone cannot indicate whether it is appropriate to expend funds on such improvements.

Because of methodological issues and volatility in cost indices over the past decade, there is no definitive answer to the question as to whether the stock is in better condition than it was when the earlier study was conducted.

When we make a simple comparison of the 1998 and 2010 overall numbers, the stock certainly looks better. The estimated total existing or backlog capital need decreased from about $36 billion in 1998 (expressed in 2010 dollars) to about $26 billion in 2010. Part of this decrease reflects the fact that there were 9 percent fewer units in 2010 (including some of those with the highest needs), but the average backlog amount per units also decreased, from just over $30,000 per unit to less than $24,000 per unit, a drop of about 21 percent.

If, however, the 2010 estimates based on inspector judgment were instead carried out using the 1998 approach to treating overage systems, the estimate of inspection-based existing needs in 2010 would be much closer to the 1998 estimate. Using this approach, the estimate of needs would be $32 billion (instead of $21 billion) and the per unit estimate would be $29,421 instead of $19,029. This represents a 3 percent decrease in total needs over the period, resulting from the 9 percent decrease in the stock and a 6 percent increase in the needs per unit (the 3 percent and 6 percent are relatively small changes which could be explained by statistical error). Adopting the 1998 approach towards overage systems also causes some accrual costs to be shifted to the backlog and this lowers the estimated accrual numbers. The 2010 estimate of average annual accrual needs becomes $2,829 instead of $3,155 per unit. It is important to understand that the use of inspector judgment does not cause repair and improvement costs to disappear—instead, it shifts the timing of certain repairs and improvements, and the resulting decrease in backlog shows up as higher accrual costs.

Another key factor that affects the amount of change occurring since the last study is the inflation factor used to make 1998 estimates comparable with 2010 numbers. During this period the CPI rose by 34 percent, which is the inflation factor used for the comparison. However, other inflation estimates could be used. In contrast to the CPI, the RS Means construction cost index rose by 59 percent, and the study's cost estimator A.M. Fogarty and Associates indicated that in their experience overall construction costs rose even more. The housing boom and bust of the past decade has increased the volatility of construction cost indices, making it difficult to select an index that is appropriate for the particular bundle of repairs and improvements that drive public housing modernization needs. If we inflate 1998 costs by 59 percent instead of 34 percent, the results would indicate a greater reduction in the backlog. We chose to use the CPI index for this study since it was the same index used in comparisons in the earlier capital needs studies. However, because the inflation factor plays such an important role in determining the degree of progress achieved since the last study, additional work on identifying a more precise measure might be warranted.

In summary, while our study tends to indicate that the condition of the public housing stock has not worsened and may have even improved significantly over the last decade, the conclusion is dependent on methodology used to estimate needs, and on some key assumptions made.

Appendix A. Sampling Approach

The congressional language mandating the study set as a requirement of the sampling strategy to select a nationally representative probability sample of 140 housing authorities.[1] From each selected housing authority, a sample of properties was inspected for a total of 548 properties. Information on conversion, modernization, or demolition strategies for each selected property was also collected. Within each property, approximately four buildings and four units were inspected. The inspected units were not necessarily contained in the four sampled buildings. The sample was used to generate statistically reliable national estimates of capital needs and accrual needs for the public housing stock as a whole and for various subgroups of interest, such as PHA size, census region, family/elderly development type, and predominant building structure type. However, the results would not be sufficiently detailed to provide statistically reliable estimates at the property or PHA level, except for the very large PHAs.

There were several considerations in developing the sampling approach.

Two sampling considerations were raised in our original response to HUD's SOW.

- The first was HUD's desire to obtain both the current level estimates of various characteristics of interest and also estimates of change from the previous period for which data are available. Because both level and change estimates are of interest, two options for the sampling design were considered.
- The second consideration relates to the selection of some properties with certainty. The statement of work called for selecting 550 properties from a sample of 140 PHAs, with the stipulation that the sample include all 162 properties with 500 or more units. These properties are distributed across 27 PHAs which, as a result, were also selected with certainty.

Additional sampling issues arose following contract award.

- Most important was the change in the definition of "development." As the public housing world has transitioned to an asset-management based approach, PHAs have consolidated old "developments" into new AMPs (asset-management projects), which are now the "developments," and in a few cases have separated old "developments" into a

[1] In the conference report 110-443 accompanying HR3074 (enacted in late December 2007), the Transportation, Treasury, Housing and Urban Development, the Judiciary and Independent Agencies Appropriations Act, 2008, the conferees stated that they directed: "HUD to perform an updated Capital Needs assessment (CNA) from funds made available under this account for the public housing portfolio, including the projected annual cost to adequately maintain that portfolio. To conduct the new CNA, HUD shall contract with a nationally recognized research entity with experience in conducting physical needs assessments of a representative sample of public housing or similar development projects. The review shall include a statistical sample for projects of 500 units or less and one-for-one review for projects in excess of 500 units…."

number of new AMPs. This resulted in a net reduction in the number of developments from about 14,530 to about 7,404. All of the very small (under 250 units) PHAs have consolidated all of their old developments into a single AMP development, and many of the larger PHAs have also consolidated a number of their old developments into larger management entities.

- A large number of developments and units (198,943 units in 1,608 developments) were categorized as scattered sites in HUD's PIC database. Scattered site developments typically include small buildings spread out over a large geographic area. Sampling and inspecting these properties would involve high costs for inspecting a small number of units.
- A number of developments have undergone HOPE VI renovations, and others have converted to mixed-finance use. Typically, these developments are relatively new and thus have capital needs considerably different from the rest of the public housing stock.

Below we discuss the implications of these issues for determining our sampling approach.

A.1. Sampling Considerations for Estimating Current Needs and Changes from 1998

For estimating change between two time periods, it is best to retain the same sample at both time periods or have a large overlap between the two samples. This is the first sampling approach discussed here. The complete overlap of the sample excluding those agencies which are no longer in operation and properties which are no longer part of the stock minimizes the variance of the estimate of difference between the two time periods. The size of the decrease in variance of the estimate of difference as compared to the variance of the difference based on two independent samples depends on the correlation between the time periods of characteristics of interest. This strategy is recommended when there have been no large changes in the universe. For example, if there have been few demolitions of developments or additions of new units or new developments since the last study, it would be useful to maintain the same sample or take a subsample of the original sample.

Alternatively, if there have been significant changes in the stock between the two periods because of new units added to the stock and demolition or conversion of old developments, then it is better to select a new sample to ensure that the sample is representative of the current time period. This is the second approach discussed here. Under this scenario, the estimate of change is based on two estimates which are both representative of the universe at each time period. It is easier to make the sample representative of the current universe when a new sample is selected. The survey could be designed in such a way as to make the sampling weights less variable. If we selected a subsample from the old sample and then supplemented it with a sample from the rest of the universe, then estimates from the combined sample could have a large variance because of the variability in sampling weights. Another advantage of using a new sample is that it takes into account all the changes that have occurred in the universe between the two time periods in addition to changes in properties and agencies which are present in both time periods.

Following extensive review of the data and close consultation with HUD staff, the study team decided that sufficient change had occurred in the universe to warrant drawing a new sample. This decision was based on a number of factors. First, sampling approach 1 (above) would have required that we study the same set of housing authorities selected for the 1998 study. However, because of the new requirement to study all developments with 500+ units (and the corresponding housing authorities), the list of housing authorities selected for this study would be substantially different from those in the earlier study. Second, approach 1 would have required that we identify and inspect the same set of developments, building and units from the earlier study. The change in the definition of "development" under the AMP system made this a very difficult, if not impossible task.

A.2. Defining the Sampling Universe

The 2008 public housing universe file we obtained from HUD in early June 2008 contained 1,205,198 units in 7,404 AMPs. To define the sampling universe, the study team made a number of important exclusions to the universe file.

- Because the study is intended to estimate the capital needs of developments likely to remain in the stock, we removed from the universe file 86,896 units with proposed and approved demolition/disposition plans, completed demolitions/dispositions, or approved HOPE VI implementation grants as of June 2008. The resulting universe file contained 1,118,302 units.[2]
- To eliminate prohibitively expensive data collection costs, the study universe includes only developments located in the contiguous 48 states, the District of Columbia, and Puerto Rico. Therefore, 10,596 units in Alaska, Hawaii, Guam, and the U.S. Virgin Islands were excluded. The resulting universe file contained 1,107,706 units.
- For the same reason, the study team decided to exclude 27,927 units in 278 developments identified in the HUD PIC system as "low density" scattered-sites (contain fewer than 1.5 units per building) because such developments would be expensive to inspect for the number of units they contain. The resulting universe file contained 1,079,779 units.
- Finally, as was done in the 1998 study, we also removed 218 units in 12 Turnkey developments from the study universe.

The final sampling universe included 1,079,561 units in 6,744 AMPs.

It contained 164 HOPE VI new developments (12,524 units) and 206 mixed-finance developments (11,378 units).[3] Given their small number, the probability of selecting these developments and units

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2 The study did not estimate the demolition and other costs associated with properties that have been approved for demolition.

3 While properties with approved HOPE VI implementation grants were excluded from the study universe, properties with completed HOPE VI grants were included.

in the inspection sample is low. The study team decided to retain them in the sampling universe. None of these types of developments were selected in the final study sample.

A.3. Selecting the Housing Authorities

The overall sampling approach we used is a multiple-stage probability sample based on probability-proportional-to-size (PPS) sampling, where size is defined by the number of public housing units available in the housing authority. The second stage sample is of ***properties***, defined as the development components according to the pre-asset management reform definition that make up each AMP.[4]

The selected sample consists of a base sample of 140 housing authorities, and a replacement sample of 5 housing authorities. The replacement sample was intended to compensate for both ineligible housing authorities and non-responses. We pursued all 145 housing authorities. Our final study sample included exactly 140 PHAs: two of the initial 145 PHAs refused to participate, and three had all ineligible properties.

Housing authorities were selected with probability proportion to size (PPS) in multiple stages. There were a total of 2,046 housing authorities in the sampling universe. In the first stage, we identified all the housing developments with 500+ units. Based on recommendations from HUD staff, the study team further restricted this set of developments to the AMPs where their lead contributing property contained 500+ units. The purpose of such restriction was to ensure that we would select developments with 500+ units in both the AMP and pre-AMP definition. There were a total of 162 such developments, spreading across 27 housing authorities. These housing authorities were therefore selected with certainty.

To select the remaining housing authorities, we defined a new sampling universe for the second stage selection by removing the 162 developments identified above as selected with certainty. The housing authorities were then selected with PPS based on the new sampling universe. However, because some of the large housing authorities would have been selected in this stage with certainty due to their size and they would inevitably overlap with the 27 certainty authorities we already selected, the target number of selected housing authorities for this stage could not be determined a *priori*. Rather, it was determined by a "trial and error" and iterative approach. After a series of trials, we found that a sample of 135 housing authorities at the second stage would yield an overall sample of 145 housing authorities (including the 27 housing authorities selected in the first stage).[5] As described above, we

4 For example, housing development with AMP code AL004000001 was created from two separate developments—AL004001 and AL004006—based on the pre-asset management reform definition. The first development contributed 164 units while the second development contributed 100 units. Therefore, in our sampling scheme, this AMP consists of two properties: 164 units from AL004001 and 100 units from AL004006.

5 The unit size threshold for selecting the certainty housing authorities at this second stage was 6,125.648, which was determined by an iterative calculation process. The probability of selection was equal to 1 for the certainty housing authorities. The selection probability for non-certainty site was equal to the total number of units at each housing authority (after removing the certainty developments), divided by 6,125.648.

targeted 145 rather than 140 PHAs to allow for some attrition of PHAs (due to having ineligible projects, scheduling difficulties or refusals),

In order to ensure representativeness along dimensions of interest to HUD, selection of the non-certainty housing authorities at the second stage was done using 18 sampling strata: 4 Census regions (Northeast, Midwest, South, and West), 4 housing authority size categories (<250 units, 250-1249 units, 1250-6600 units, and 6600 units), New York City Housing Authority, and Puerto Rico Housing Authorities.

Exhibit A-4 at the end of this appendix presents the list of 145 PHAs selected for the study, sorted by Census region, and within region by size category and total number of units.

Exhibit A-1 compares the sampling universe of housing authorities with the selected sample. As expected, it shows that large and extra-large housing authorities are over-represented in the sample. This result is consistent with our probability proportional to size sampling plan.

Exhibit A-1. Description of Sampling Universe and Sample of Housing Authorities

	Sampling Universe		Sample	
	Number	Percent	Number	Percent
Housing Authorities by Region				
Northeast	413	13.6	36	24.8
Midwest	899	29.5	32	22.1
South	1,510	49.6	64	44.1
West	224	7.4	13	9.0
Total	3,046	100.0	145	100.0
Housing Authorities by Authority Size				
Less than 250 units	2,289	75.2	35	24.1
250 – 1,249 units	633	20.8	48	33.1
1,250 – 6,600 units	113	3.7	51	35.2
More than 6,600 units	11	0.4	11	7.6
Total	3,046	100.0	145	100.0

Notes: Excludes housing authorities in Alaska, Hawaii, Guam, and the U.S. Virgin Islands.

A.4. Selecting the Developments within Selected Housing Authorities

Developments were selected in a multi-stage framework. As noted above, the statement of work required that we include the all developments with 500+ units. The study team identified a total of 162 such developments (see previous section). Over half of these developments are located in New York City (NYC). We initially recommended *not* inspecting all of these developments so as not to have the very large developments in NYC comprise the resulting nearly 20 percent of the overall sampled developments (100 out of the 550). In the 1998 study we sampled fewer developments than a representative portion in NYC for the same reasons. However, after close consultation with HUD staff, the study team determined that selecting a subsample from NYC among the 162 was not an option. All these 162 very large developments were therefore part of the inspection sample. These developments constitute the certainty portion of the sampled developments and were inspected according to the standard protocol.

The selection for the remaining 388 non-certainty developments could not be done based on AMPs because that would have yielded a sample with more than 388 "developments" to inspect, which would have been beyond the cost scope of the study. (Recall that for the very small housing authorities, each consolidated all their developments into a single AMP in the post-asset management reform world, and many large PHAs consolidated former properties.) Nor could we focus the sample exclusively on 388 old "developments," because all future data collection and management at HUD/housing authorities will be at the AMP level. Therefore, for sampling purposes, the selection for the remaining developments was based on the property definition discussed above. The properties identify the components of old developments that moved into the new AMPs.[6]

To carry out the selection, we first removed the 162 certainty developments from the sampling universe. Next, we further restricted the sample to the 135 housing authorities identified at the second stage of the housing authority selection. Developments for each housing authorities were sorted by AMP, and within each AMP by property. To account for non-responses, the study team determined that a sample of 404 properties was required, which would yield a sufficient number of replacement properties. This implied that we would need to pick on average 3 properties from each of the 135 housing authorities. However, given that some of the small housing authorities have fewer than 3 properties, other housing authorities in the list were over-sampled to ensure that we obtained a sample of 404 distinct properties. The properties were selected with probability proportion to size.[7]

To summarize, the initial list of sampled properties contains 162 certainty AMPs and 404 non-certainty properties, arriving at a total of 566. This allowed for a replacement sample of 16 properties.

A.5. Selecting the Buildings and Units within Selected Developments

Within each selected property we sampled approximately four buildings and four units at random. (The four sampled units did not necessarily come from the sampled buildings). We assume that the randomly selected buildings and units represent all buildings and units in the property. This approach is slightly different from earlier studies. In the earlier studies we asked property managers to rate the

[6] One implication is that in general we cannot generate "development-level" estimates, but rather PHA- and stock-wide estimates of capital need. There are exceptions. For the 162 certainty developments and developments that have not changed configuration after the AMP transition, generating development-level estimates is feasible.

[7] The selection probability for the certainty developments was equal to 1. When selecting the properties among the certainty housing authorities, the selection probability was equal to the number units at the property, divided by 2007.307. The threshold was determined in an iterative calculation process. Selection probability for the remaining properties was (6125.648/2007.307)*number of units at the property/number of units at the housing authority (after removing the certainty developments).

condition of each building and unit as excellent, good, fair or poor. We then selected buildings and units to inspect based on the ranking, where we always inspected the poorer qualities. We developed a series of algorithms to infer capital needs of uninspected qualities based on inspected qualities. We found that the manager ratings were not always borne out in the field—sometimes poorer rated units/buildings did not require as much work as better rated units/buildings. Thus, for this study, we picked units/buildings randomly within the selected property and assumed they reflect the actual property distribution. (While for a particular property this may not be accurate, for the stock as a whole it likely is). For developments with multiple building types (high-rises, garden apartments, walk-ups, etc.), we samples at least one building of each type in the property which improves the reliability of the estimates. Similarly, except for cases described below, we inspected at least one unit of each bedroom size category.

Sampling Approach for Buildings

Below we describe the sampling approach for buildings. As noted above, for this study we inspected at least one of each building type in the property.

- If there were four or fewer buildings in the development, all buildings were inspected.
- If there were more than four buildings, buildings were sampled based on the following:
  - If there were ***four different building types*** (single family, townhouse, walk-up, high-rise), we inspected one building of each type. The specific buildings within each type were selected at random using a random number generator.[8]
  - If there were ***three building types***, we inspected one of each building type, and then selected the one remaining building from the category of buildings with the most units. (For example, if a property had two high-rises each with 100 units, 10 walk-ups each with 4 units, and 40 single family attached homes each with 2 units—we inspected both high rises, one walk-up, and one single family attached home, because there were 200 units in the high-rises, 40 in the walk-ups and 80 in the single family attached units). The specific buildings within each type were selected at random using a random number generator.
  - If there were ***two building types***, we inspected one of each building type, and then select the two remaining buildings based on the distribution of the number of units by building type. If more than three quarters of the units were in a specific building type, we inspected three of that type of building, and one of the other type. Otherwise, we inspected two of each building type. (For example, if a property had four high-rises each with 50 units and 10 walk-ups each with 4 units, we inspected three high rises, and one walk-up because more than three quarters of the units were in the high rises (200 units out of a total of 240). However, if the walk-ups each had 8 units, we inspected two high rises and two walk-ups because 200 is less than three quarters of the total 280 units). The specific buildings within each type were selected at random using a random number generator. In the first example, the costs for the uninspected high rise would reflect the average across the three inspected high rises,

[8] The random number generator used for this study can be found at: http://www.random.org/sequences/

and the costs for the 9 uninspected walk-ups would reflect the cost for the one inspected walk-up. In the second example, the costs for the uninspected high rises would reflect the average across the two inspected high rises, and the average for the 8 uninspected walk-ups would reflect the average across the two inspected walk-ups.

Sampling Approach for Units

The approach for sampling specific units for inspection is described below:

- When selecting the units for inspection, we ignored the building type dimension and grouped the units together by unit size. In other words, the selection of units was independent of the selection of buildings; the selected units may or may not have been located in the selected buildings.
- Where possible, we counted all "occupiable" units in the sampling frame (in other words we included occupied and vacant units—but not off-line units).
- The one key difference between the building and unit sampling is that if there were very few of a specific unit size (which we defined as fewer than 10% of occupiable units) we combined them for sampling and analysis purposes with another category. If the very small size category was "0" BRs they were combined with "1" BRs, if the small sizes were 1 BRs, they were combined with 2 BRs (unless the rest of the units were studios—then the 1BRs were combined with the studios), if the small size was 2BRs they were combined with 1 BRs, and if the small size was 3+ BRs they were be combined with 2 BRs.

  For example, if a property had 95 studios, and 5 1BR units, we included all 100 units into a single sampling category. If the property had 90 studios and 10 1 BRs we kept the 1 BRs as a separate category.

- If there were ***four different sized units*** we inspected one unit of each of the four sizes, subject to the caveat above. The specific units within each size category were selected at random using a random number generator.
- If there were ***three unit sizes***, we inspected one of each unit size subject to the caveat above, and then selected the one remaining unit from the size with the most units. (For example, if a property had 100 1-BR units, 50 2-BR units, and 20 3-BR units we inspected two 1-BR units, one 2BR-unit, and one 3-BR unit). The specific units within each size category were selected at random using a random number generator. But if the property had 100 1-BR units, 50 2-BR units, and 4 3-BR units we combined the 3 BR units with the 2 BR units, and inspected two 1-BR units, and two of the combined 2BR/3BR category).
- If there were ***two unit sizes***, we inspected one of unit of each size, and then selected the two remaining units based on the distribution of the number of units by size. If more than three quarters of the units were of a specific size, we inspected three of that sized units, and one of the other size. Otherwise, we inspected two of each unit size (For example, if a property had 200 1-BR units, and 40 2BR units, we inspected three 1-BR units, and one

2-BR unit because more than three quarters of the units had 1-BR (200 units out of a total of 240). However, if there were 80 2-BR units instead of 40, then we inspected two 1-BR units and two 2BR-units because 200 is less than three quarters of the total 280 units). The specific units within each size category were selected at random using a random number generator. In the first example, the costs for the 197 uninspected 1-BR units would reflect the average across the three inspected 1-BRs, and the costs for the 39 uninspected 2-BRs would reflect the cost for the one inspected 2-BR unit. In the second example, the costs for the 198 uninspected 1-BRs would reflect the average across the two inspected 1-BRs, and the average for the 38 uninspected 2-BRs would reflect the average across the two inspected 2-BR units.

A.6. Changes in the Sample/Weights Identified During the Inspection Process

During the inspection process a number of changes took place to the sample and the resulting estimate of the universe.

- **Single family/low density scattered site homes**. In addition to the 27,927 units in 278 developments that were identified as single family or low density scattered site homes in the sampling file, during the inspection process we dropped an additional 1,156 units in 22 developments because they were also single family/low density scattered site homes. This translates to approximately 54,197 units weighted in the universe.
- **Demolished developments**. In addition to the 86,896 units with proposed and approved demolition/disposition plans, completed demolitions/dispositions, or approved HOPE VI implementation grants as of June 2008 that were dropped from initial sample, as part of the inspection process we identified another 1,393 units in 6 developments that have been demolished or with approved demolition plans. This translates to approximately 12,044 units weighted in the universe.
- **No longer owned by PHA**. During the inspection process we identified 675 units in 5 developments that were no longer owned by the PHA. This translates to approximately 10,037 units weighted in the universe.
- **Undergoing modernization at the time of inspection**. During the inspection process we identified 5,199 units in 8 developments that were undergoing modernization at the time of inspection and thus could not be inspected. This translates to approximately 6,972 units weighted in the universe.[9]
- **Refusals**. A total of 921 units in 5 developments were dropped because the PHA refused to participate. This translates to approximately 16,058 units weighted in the universe.

By dropping these units, the resulting estimate of the inspection universe contained 980,252 units.

9 Most of these units were in the Chicago PHA, which is self-representing.

Towards the end of the inspection process, we realized the sample would fall slightly short of the target of 550 developments in 140 PHAs. HUD asked us to add additional properties in the remaining PHAs and to go back to two PHAs that were initially dropped due to all ineligible properties. As a result we added a number of properties as follows:

- **CA003 Oakland**. The initial 3 properties that were selected (157 units) were all dropped because they were demolished. Towards the end of the study we added 3 additional properties (261 units) to keep the sample up. Weights were adjusted to reflect the lower estimate of the size of the PHA.
- **UT007 Provo**. The initial 3 properties selected (with 115 units) were all ineligible because they were all low density scattered sites. When HUD asked to increase the sample size we went back to Provo and sampled 2 properties with 55 units.
- **CA004 City of Los Angeles**. In LA we added 2 properties, selected at random, we lowered the weights of the other properties to reflect this addition, but kept the total weight of the PHA constant.
- **DC001 Washington DC**. We originally sampled 4 properties with a total of 803 units. All four properties were dropped—three, with a total of 449 units were undergoing modernization at the time, and one (92 units) had been sold to private ownership. As one of the last PHAs to be inspected, HUD asked us to increase the sample to 6 developments. We ended up inspecting 6 properties with at total of 1,215 units. The weights were adjusted to reflect the revised estimate of the size of the PHA (based on the non-PHA units).
- **IL002 Chicago**. We originally planned to inspect 16 properties with a total of 6,569 units in Chicago. A total of 7 properties with 4,965 units are in the process of being modernized. Large portions have been demolished and the rest are vacant being modernized. One additional property was totally demolished (390 units). Two properties (130 units) were dropped as low density scattered site, and one property was sold to a private developer (94 units). Thus 11 properties, with a total of 5,554 units, were dropped. As one of the last PHAs to be inspected, HUD wanted to increase the sample so we added 14 more properties with a total of 2,500 units in Chicago for a total of 19 inspected properties. Because the properties were undergoing modernization and the scattered site properties were mostly family properties and the sample of properties was selected randomly (without regard to family/elderly status), elderly properties were over-represented in the inspected sample. To correct for this imbalance, we adjusted the sampling weights so that the ratio of the weighted number of units for the family and elderly properties conform to the ratio in the sampling frame. This step is often referred to as poststratification adjustment to the sampling weights.
- **NC003 Charlotte, NC**. We initially sampled 3 developments with 876 units. Initially the PHA refused to participate, but ultimately agreed. Because they were among the last PHAs to be inspected, HUD asked us to add developments, so we sampled 4 additional properties. The PHA agreed to let us inspect 3 properties total from among these seven.

There were three small-size PHAs where all developments were sampled and all were determined to be ineligible:

- **MO013 Wellston:** Two developments with 201 units. Both dropped because they were widely scattered sites.
- **LA122 Colfax:** PHA had 2 properties totaling 90 units. Both were dropped because they were single family homes.
- **OK 113 Fort Cobb:** PHA had 1 property with 20 units. Property and PHA dropped because the one development was single family homes.

A total of two PHAs refused to participate in the study:

- **MN003 Henning**: One development with 20 units.
- **NY086 North Hempstead**: PHA had two developments with 189 units.

Finally, there were changes to the actual number of units in properties. The sample of properties was selected PPS with the measure of size being the number of units. Properties with over 500 units were selected with certainty. When the inspectors went out to the properties, they found that the actual number of units in some developments turned out to be different from what HUD's files showed. In some cases the numbers are very close, but in others the numbers were quite different, often because of off-line buildings. In these cases, we followed up with the PHAs to verify the correct numbers of units, and the unit counts in the final analysis file and reflected in the weights rely on these corrected numbers.

The final inspection sample consists of ***548*** properties. Exhibit A-5 at the end of this appendix provides a comprehensive list of the 548 sampled properties, sorted by housing authority size category.

A.7. Changes in the Weights Post-Inspection

Following the inspections, we adjusted the sampling weights to re-incorporate certain categories of properties that were dropped from the inspection universe, but were to be included in the analysis universe.

- **Single family/low density scattered site homes**. We added back in the 82,124 units (weighted) that were dropped because they were low density scattered site. This includes both the 27,927 units that were dropped from the initial sampling frame, and the 54,197 units that were identified during the inspection process.
- **Undergoing modernization at the time of inspection**. We added back in the 6,972 units that were dropped because they were undergoing modernization at the time of the inspection.

- **Refusals**. We added back in the 16,058 units that were dropped because the PHA refused to participate.

The resulting estimate of the inspection universe is ***1,085,407*** units

Exhibit A-2 summarizes the changes to the definition of the study universe.

Exhibit A-2. Number of Units in the Study Universe

Initial Universe

- HUD file from June 2008 contained ***1,205,198*** units
  - » Dropped: 86,896 proposed/approved demolition/ HOPE VI units
  - » Dropped 10,596 units in Alaska, Hawaii, Guam, and the U.S.V.I
  - » Dropped 27,927 unit in low-density scattered site developments
  - » Dropped 218 units in Turnkey developments
- The resulting universe file contained ***1,079,561*** units.

Changes During the Inspection Process

- » Dropped 1,156 units that were single family/low density scattered site homes. Translates to 54,197 units weighted in the universe.
- » Dropped 1,393 units because they were in demolished developments. Translates to 12,044 units weighted in the universe.
- » Dropped 921 units because the PHA refused to participate. Translates to 16,058 units weighted in the universe.
- » Dropped 675 units because they were no longer owned by the PHA. Translates to 10,037 units weighted in the universe.
- » Dropped 5,199 units because they were under modernization at the time of inspection. Translated to 6,972 units weighted in the universe.

- Note that some of the dropped units were in replacement properties
- By dropping these units, the resulting estimate of the inspection universe contained ***980,252*** units.

Post-Inspection Changes to the Universe

- » Added back in the 82,124 units (weighted) that were dropped because they were low density scattered site
- » Added back in the 16,058 units that were dropped because the PHA refused to participate.
- » Added back in the 6,972 units that were dropped because they were undergoing modernization at the time of the inspection.

- The resulting estimate of the inspection universe is ***1,085,407*** units
  - » Added in the 10,596 units in Alaska, Hawaii, Guam and the USVI,
- The total estimated number of units is ***1,096,003***.

A.8. Summary Comparison of Universe and Sample Characteristics

Exhibit A-3 compares the initial sampling universe with the weighted sample (representing the post-inspection universe). It shows that our initial sample represented the universe of public housing stock very well along a series of characteristics including census region, HA size, family/elderly occupancy, and development size.

Exhibit A-3.

	Sampling Universe		Post-Inspection Universe (weighted inspection sample)		Final Sample	
	Number	Percent	Number	Percent	Number	Percent
Housing Units by Census Region						
Northeast	404,909	37.5	403,265	37.2	239	43.6
Midwest	205,008	19	208,666	19.2	91	16.6
South	387,356	35.9	389,508	35.9	178	32.5
West	82,288	7.6	83,968	7.7	40	7.3
Total	1,079,561	100	1,085,407	100	548	100
Housing Units by Authority Size						
Less than 250 units	205,085	19	192,268	17.7	60	11.0
250 – 1,249 units	304,211	28.2	302,365	27.9	129	23.5
1,250 – 6,600 units	267,439	24.8	279,850	25.8	147	26.8
More than 6,600 units	302,826	28.1	310,924	28.7	212	38.7
Total	1,079,561	100	1,085,407	100	548	100
Housing Units by Occupancy Type						
Elderly	313,073	29.0	325,415	30.0	148	27.0
Family	766,488	71.0	759,992	70.0	400	73.0
Total	1,079,561	100	1,085,407	100	548	100
Housing Units by Development Size						
Less than 300 units	724,385	67.1	740,248	68.2	378	69.0
300 or more units	355,176	32.9	345,159	31.8	170	31.0
Total	1,079,561	100	1,085,407	100	548	100

Notes: Excludes housing authorities in Alaska, Hawaii, Guam, and the U.S. Virgin Islands. Unit counts exclude approved and proposed demolitions, those with HOPE VI implementation grants, scattered-sites with fewer than 1.5 units per building, and Turnkey developments.

A.9. Sample PHAs and Developments

The following exhibits identify the PHAs and developments within those PHAs selected for the study.

Exhibit A-4. Sample of 145 Housing Authorities

Census Region	PHA Size Category	PHA Code	PHA Name	Units
Midwest	< 250 units	MN083	HOUSING & REDEVELOPMENT AUTHORITY OF HENNING	20
Midwest	< 250 units	WI067	PRAIRIE DU CHIEN HOUSING AUTHORITY	40
Midwest	< 250 units	MI053	ALLEN PARK HOUSING COMMISSION	61
Midwest	< 250 units	WI076	WATERTOWN HOUSING AUTHORITY	80
Midwest	< 250 units	OH023	LONDON METROPOLITAN HOUSING AUTHORITY	100
Midwest	< 250 units	IA127	NORTH IOWA REGIONAL HOUSING AUTHORITY	121
Midwest	< 250 units	WI045	SHAWANO HOUSING AUTHORITY	146
Midwest	< 250 units	MI083	ESCANABA HOUSING COMMISSION	175
Midwest	< 250 units	MO138	HOUSING AUTHORITY OF THE CITY OF WELLSTON	201
Midwest	< 250 units	OH042	GEAUGA METROPOLITAN HOUSING AUTHORITY	243
Midwest	250-1,249 units	MO188	JOPLIN HOUSING AUTHORITY	275
Midwest	250-1,249 units	MN085	AUSTIN HRA	305
Midwest	250-1,249 units	IN023	HOUSING AUTHORITY OF THE CITY OF JEFFERSONVILLE	369
Midwest	250-1,249 units	MI039	PORT HURON HOUSING COMMISSION	443
Midwest	250-1,249 units	IL018	HOUSING AUTHORITY OF THE CITY OF ROCK ISLAND	487
Midwest	250-1,249 units	MO013	HOUSING AUTHORITY OF THE CITY OF POPLAR BLUFF	576
Midwest	250-1,249 units	IL061	HOUSING AUTHORITY OF THE COUNTY OF FRANKLIN	684
Midwest	250-1,249 units	WI003	MADISON COMMUNITY DEVELOPMENT AUTHORITY	766
Midwest	250-1,249 units	IL014	HOUSING AUTHORITY FOR LASALLE COUNTY	948
Midwest	1,250-6,600 units	OH001	COLUMBUS METROPOLITAN HOUSING AUTHORITY	1,275
Midwest	1,250-6,600 units	IL022	ROCKFORD HOUSING AUTHORITY	1,620
Midwest	1,250-6,600 units	IL001	THE HOUSING AUTHORITY OF CITY OF EAST ST. LOUIS	1,891
Midwest	1,250-6,600 units	NE001	OMAHA HOUSING AUTHORITY	2,129
Midwest	1,250-6,600 units	MI001	DETROIT HOUSING COMMISSION	2,698
Midwest	1,250-6,600 units	OH005	DAYTON METROPOLITAN HOUSING AUTHORITY	2,761
Midwest	1,250-6,600 units	WI002	HOUSING AUTHORITY OF THE CITY OF MILWAUKEE	3,537
Midwest	1,250-6,600 units	OH007	AKRON METROPOLITAN HOUSING AUTHORITY	3,543
Midwest	1,250-6,600 units	MN001	PUBLIC HOUSING AGENCY OF THE CITY OF SAINT PAUL	3,886
Midwest	1,250-6,600 units	OH004	CINCINNATI METROPOLITAN HOUSING AUTHORITY	5,092
Midwest	1,250-6,600 units	MN002	MINNEAPOLIS PHA IN AND FOR THE CITY OF MINEAPOLIS	5,454
Midwest	> 6,600 units	OH003	CUYAHOGA METROPOLITAN HOUSING AUTHORITY	10,130
Midwest	> 6,600 units	IL002	CHICAGO HOUSING AUTHORITY	22,155
Northeast	< 250 units	ME015	WESTBROOK HOUSING AUTHORITY	85
Northeast	< 250 units	NY033	RENSSELAER HOUSING AUTHORITY	146
Northeast	< 250 units	NY086	NORTH HEMPSTEAD HOUSING AUTHORITY	189
Northeast	< 250 units	CT022	NEW LONDON HOUSING AUTHORITY	223

Exhibit A-4. Sample of 145 Housing Authorities

Census Region	PHA Size Category	PHA Code	PHA Name	Units
Northeast	250-1,249 units	NJ016	HARRISON HOUSING AUTHORITY	268
Northeast	250-1,249 units	NY025	WATERVLIET HOUSING AUTHORITY	307
Northeast	250-1,249 units	NY070	LOCKPORT HOUSING AUTHORITY	352
Northeast	250-1,249 units	PA043	NANTICOKE HOUSING AUTHORITY	417
Northeast	250-1,249 units	NH003	DOVER HOUSING AUTHORITY	458
Northeast	250-1,249 units	NJ063	VINELAND HA	528
Northeast	250-1,249 units	RI006	CRANSTON HOUSING AUTHORITY	587
Northeast	250-1,249 units	NJ037	IRVINGTON HA	661
Northeast	250-1,249 units	NY042	WHITE PLAINS HOUSING AUTHORITY	712
Northeast	250-1,249 units	PA047	WILKES BARRE HOUSING AUTHORITY	883
Northeast	250-1,249 units	ME003	PORTLAND HOUSING AUTHORITY	1,005
Northeast	250-1,249 units	PA004	ALLENTOWN HOUSING AUTHORITY	1,103
Northeast	1,250-6,600 units	NY012	TROY HOUSING AUTHORITY	1,260
Northeast	1,250-6,600 units	MA035	SPRINGFIELD HOUSING AUTHORITY	1,327
Northeast	1,250-6,600 units	NJ015	HOBOKEN HA	1,364
Northeast	1,250-6,600 units	PA019	JOHNSTOWN HOUSING AUTHORITY	1,505
Northeast	1,250-6,600 units	MA006	FALL RIVER HOUSING AUTHORITY	1,569
Northeast	1,250-6,600 units	PA009	READING HOUSING AUTHORITY	1,610
Northeast	1,250-6,600 units	MA001	LOWELL HOUSING AUTHORITY	1,641
Northeast	1,250-6,600 units	PA008	HARRISBURG HOUSING AUTHORITY	1,657
Northeast	1,250-6,600 units	NY003	THE MUNICIPAL HSNG AUTHORITY CITY YONKERS	2,029
Northeast	1,250-6,600 units	MA012	WORCESTER HOUSING AUTHORITY	2,110
Northeast	1,250-6,600 units	NY001	SYRACUSE HOUSING AUTHORITY	2,321
Northeast	1,250-6,600 units	NJ009	JERSEY CITY HA	2,368
Northeast	1,250-6,600 units	CT001	BRIDGEPORT HOUSING AUTHORITY	2,481
Northeast	1,250-6,600 units	PA001	HOUSING AUTH CITY OF PITTSBURGH	3,895
Northeast	1,250-6,600 units	NY002	BUFFALO MUNICIPAL HOUSING AUTHORITY	4,067
Northeast	> 6,600 units	NJ002	NEWARK HA	7,441
Northeast	> 6,600 units	PA002	PHILADELPHIA HOUSING AUTHORITY	10,195
Northeast	> 6,600 units	MA002	BOSTON HOUSING AUTHORITY	11,055
Northeast	> 6,600 units	RQ005	PUERTO RICO PUBLIC HOUSING ADMINISTRATION	48,805
Northeast	> 6,600 units	NY005	NEW YORK CITY HOUSING AUTHORITY	158,847
South	< 250 units	OK113	HOUSING AUTHORITY OF THE TOWN OF FORT COBB	20
South	< 250 units	TX118	HOUSING AUTHORITY OF THE CITY OF CALDWELL	40
South	< 250 units	GA283	TALBOT COUNTY CONSOL HA	54
South	< 250 units	KY147	HOUSING AUTHORITY OF MCKEE	66
South	< 250 units	AL156	HOUSING AUTHORITY OF THE CITY OF BREWTON	80
South	< 250 units	LA122	COLFAX HOUSING AUTHORITY	90
South	< 250 units	TX168	HOUSING AUTHORITY OF THE CITY OF DAYTON	100
South	< 250 units	GA135	HOUSING AUTHORITY OF THE CITY OF HOGANSVILLE	114
South	< 250 units	LA040	HOUSING AUTHORITY OF THE CITY OF ST. MARTINVILLE	124
South	< 250 units	KY028	HOUSING AUTHORITY OF BARBOURVILLE	141
South	< 250 units	TX063	HOUSING AUTHORITY OF THE CITY OF HEARNE	150
South	< 250 units	AL051	HOUSING AUTHORITY OF RED BAY	164

Exhibit A-4. Sample of 145 Housing Authorities

Census Region	PHA Size Category	PHA Code	PHA Name	Units
South	< 250 units	WV014	HOUSING AUTHORITY OF THE CITY OF BENWOOD	177
South	< 250 units	AL122	CHILDERSBURG HOUSING AUTHORITY	190
South	< 250 units	MS078	THE HOUSING AUTHORITY OF THE CITY OF WATER VALLEY	200
South	< 250 units	KY043	HOUSING AUTHORITY OF FULTON	212
South	< 250 units	TX018	HOUSING AUTHORITY OF LUBBOCK	226
South	< 250 units	TN063	SEVIERVILLE HOUSING AUTHORITY	245
South	250-1,249 units	TN014	FAYETTEVILLE HOUSING AUTHORITY	268
South	250-1,249 units	AL166	HOUSING AUTHORITY OF THE CITY OF CHICKASAW	288
South	250-1,249 units	AL189	TOP OF ALABAMA REGIONAL HOUSING AUTHORITY	300
South	250-1,249 units	FL002	HOUSING AUTHORITY OF THE CITY OF ST. PETERSBURG	313
South	250-1,249 units	SC023	HOUSING AUTHORITY OF SUMTER	327
South	250-1,249 units	NC021	HOUSING AUTHORITY OF THE COUNTY OF WAKE	345
South	250-1,249 units	AR031	HOT SPRINGS HOUSING AUTHORITY	375
South	250-1,249 units	MS077	THE HOUSING AUTHORITY OF THE CITY OF TUPELO	388
South	250-1,249 units	TN065	MARYVILLE HOUSING AUTHORITY	400
South	250-1,249 units	TN029	GALLATIN HOUSING AUTHORITY	429
South	250-1,249 units	KY019	HOUSING AUTHORITY OF MIDDLESBOROUGH	463
South	250-1,249 units	VA005	HOPEWELL REDEVELOPMENT & H/A	491
South	250-1,249 units	FL073	TALLAHASSEE HOUSING AUTHORITY	503
South	250-1,249 units	LA005	HOUSING AUTHORITY OF THE CITY OF LAFAYETTE	572
South	250-1,249 units	TN038	MORRISTOWN HOUSING AUTHORITY	602
South	250-1,249 units	FL010	HOUSING AUTHORITY OF THE CITY OF FORT LAUDERDALE	637
South	250-1,249 units	FL007	HOUSING AUTHORITY OF THE CITY OF DAYTONA BEACH	691
South	250-1,249 units	NC020	HOUSING AUTHORITY OF THE CITY OF WILSON	781
South	250-1,249 units	LA004	HOUSING AUTHORITY OF LAKE CHARLES	833
South	250-1,249 units	SC003	HOUSING AUTHORITY OF SPARTANBURG	972
South	250-1,249 units	MD018	ANNE ARUNDEL COUNTY HOUSING AUTH.	1,026
South	250-1,249 units	TN012	LAFOLLETTE HOUSING AUTHORITY	1,121
South	250-1,249 units	VA011	ROANOKE REDEVELOPMENT & H/A	1,228
South	1,250-6,600 units	LA006	HOUSING AUTHORITY OF MONROE	1,329
South	1,250-6,600 units	NC002	RALEIGH HA	1,409
South	1,250-6,600 units	MD004	HOUSING OPPRTY COM OF MONTGOMERY CO	1,538
South	1,250-6,600 units	GA004	HOUSING AUTHORITY OF THE CITY OF COLUMBUS	1,694
South	1,250-6,600 units	TX008	CORPUS CHRISTI HOUSING AUTHORITY	1,836
South	1,250-6,600 units	GA007	HOUSING AUTHORITY OF THE CITY OF MACON	1,946
South	1,250-6,600 units	FL001	JACKSONVILLE HOUSING AUTHORITY	2,682
South	1,250-6,600 units	LA001	HOUSING AUTHORITY OF NEW ORLEANS	2,715
South	1,250-6,600 units	NC003	HOUSING AUTHORITY OF THE CITY OF CHARLOTTE	2,781
South	1,250-6,600 units	FL003	TAMPA HOUSING AUTHORITY	2,906
South	1,250-6,600 units	AL002	MOBILE HOUSING BOARD	3,260
South	1,250-6,600 units	VA006	NORFOLK REDEVELOPMENT & H/A	3,338

Exhibit A-4. Sample of 145 Housing Authorities

Census Region	PHA Size Category	PHA Code	PHA Name	Units
South	1,250-6,600 units	TN003	KNOXVILLE COMMUNITY DEVEL CORP	3,662
South	1,250-6,600 units	TX005	HOUSING AUTHORITY OF THE CITY OF HOUSTON	3,708
South	1,250-6,600 units	VA007	RICHMOND REDEVELOPMENT & H/A	3,852
South	1,250-6,600 units	KY001	HA LOUISVILLE	4,112
South	1,250-6,600 units	AL001	HOUSING AUTHORITY OF THE BIRMINGHAM DISTRICT	4,939
South	1,250-6,600 units	TN005	METROPOLITAN DEVELOPMENT & HOUSING AGENCY	5,332
South	1,250-6,600 units	TX003	HOUSING AUTHORITY OF EL PASO	5,649
South	1,250-6,600 units	TX006	SAN ANTONIO HOUSING AUTHORITY	6,133
South	> 6,600 units	DC001	D.C HOUSING AUTHORITY	7,971
South	> 6,600 units	FL005	MIAMI-DADE HOUSING AUTHORITY	9,120
South	> 6,600 units	MD002	HOUSING AUTHORITY OF BALTIMORE CITY	10,293
West	< 250 units	CA041	CITY OF BENICIA HSG AUTH	75
West	< 250 units	AZ003	CITY OF GLENDALE HOUSING AUTHORITY	155
West	< 250 units	UT007	HOUSING AUTHORITY OF THE CITY OF PROVO	248
West	250-1,249 units	CA023	COUNTY OF MERCED HOUSING AUTHORITY	412
West	250-1,249 units	OR006	HA & COMMUNITY SERVICES AGENCY OF LANE COUNTY	578
West	250-1,249 units	CA030	TULARE COUNTY HOUSING AUTH	710
West	250-1,249 units	CA024	COUNTY OF SAN JOAQUIN HOUSING AUTH.	996
West	1,250-6,600 units	OR002	HOUSING AUTHORITY OF PORTLAND	2,355
West	1,250-6,600 units	CA002	HOUSING AUTHORITY OF THE COUNTY OF LOS ANGELES	2,960
West	1,250-6,600 units	CA003	OAKLAND HOUSING AUTHORITY	3,164
West	1,250-6,600 units	WA001	SEATTLE HOUSING AUTHORITY	4,991
West	1,250-6,600 units	CA001	SAN FRANCISCO HSG AUTH	6,248
West	> 6,600 units	CA004	HOUSING AUTHORITY OF THE CITY OF LOS ANGELES	6,814

Notes: Excludes housing authorities in Alaska, Hawaii, Guam, and the U.S. Virgin Islands. Unit counts exclude approved and proposed demolitions, those with HOPE VI implementation grants, scattered-sites with fewer than 1.5 units per building, and Turnkey developments.

Exhibit A-5. Final Sample of Housing Developments

Developments from Housing Authorities with Fewer than 250 Units

AL051	**HOUSING AUTHORITY OF RED BAY**	**UNITS**
AL051003	ELLIOTT VILLAGE	30
AL051004	ELLIOTT VILLAGE	50
AL051006	5TH COURT	50
AL122	**CHILDERSBURG HOUSING AUTHORITY**	
AL122002	FAIRMONT	30
AL122003	SUNSET	50
AL122004	SADIE LEE	69
AL156	**HOUSING AUTHORITY OF THE CITY OF BREWTON**	
AL156002	WASHINGTON CIRCLE	42
AL156006	BRYANT CIRCLE	31
AZ003	**CITY OF GLENDALE HOUSING AUTHORITY**	
AZ003001	FREY FRANCISCO PORRAS	48
AZ003002	GLENDALE HOMES	70
AZ003004	CHOLLA VISTA HOMES	34
CA041	**CITY OF BENICIA HSG AUTH**	
CA041001	CAPITAL HEIGHTS	75
CT022	**NEW LONDON HOUSING AUTHORITY**	
CT022001	THAMES RIVER	124
CT022002	WILLIAMS PARK HOUSING	99
GA135	**HOUSING AUTHORITY OF THE CITY OF HOGANSVILLE**	
GA135000	MELSON HOMES	24
IA127	**NORTH IOWA REGIONAL HOUSING AUTHORITY**	
IA127001	FOREST CITY - SCATTERED SITE	27
IA127004	HERITAGE PLACE	27
IA127008	SCATTERED SITE # 8	42
KY028	**HOUSING AUTHORITY OF BARBOURVILLE**	
KY028001	PAUL BUCHANAN CT.	37
KY028002	MACKEY VILLAGE	29
KY028003	CHURCH HILL COURT	73
KY043	**HOUSING AUTHORITY OF FULTON**	
KY043002	OAK HEIGHTS II - WESTWOOD	42
KY043003	NORTH GATE	79
KY147	**HOUSING AUTHORITY OF MCKEE**	
KY147001	ROCKY HILL HEIGHTS	66
LA040	**HOUSING AUTHORITY OF THE CITY OF ST. MARTINVILLE**	
LA040002	LESTER JOURNET HOMES	30
LA040003	EAST SIDE HOUSING	68
ME015	**WESTBROOK HOUSING AUTHORITY**	
ME015001	RIVERVIEW TERRACE	53
MI053	**ALLEN PARK HOUSING COMMISSION**	
MI053001	LEO PALUCH SENIOR HSG	61
MI083	**ESCANABA HOUSING COMMISSION**	
MI083001	HARBOR TOWER	175

MS078	**THE HOUSING AUTHORITY OF THE CITY OF WATER VALLEY**	**UNITS**
MS078001	HAMMER DAVIDSON	44
MS078004	ROLLING HILLS	138
NY033	**RENSSELAER HOUSING AUTHORITY**	
NY033001	JOHN WARDEN APTS	85
NY033002	PATROON DORP	60
OH023	**LONDON METROPOLITAN HOUSING AUTHORITY**	
OH023001	London Metropolitan Housing Authority	100
OH042	**GEAUGA METROPOLITAN HOUSING AUTHORITY**	
OH042001	STRICKLAND ARMS	30
OH042002	CLOVER DALE ESTATES I	87
OH042003	MURRAY MANOR	75
OH042007	HARRIS HOUSE	50
TN063	**SEVIERVILLE HOUSING AUTHORITY**	
TN063002	ROBERT S. HOWARD I	71
TN063004	ROBERT S. HOWARD ADDITION	40
TN063005	RIDGEWOOD VILLAGE/PIGEON FORGE	92
TX018	**HOUSING AUTHORITY OF LUBBOCK**	
TX018001	BEHNER PLACE I	36
TX018005	96TH STREET WEST	96
TX018007	MARY MYERS	48
TX063	**HOUSING AUTHORITY OF THE CITY OF HEARNE**	
TX063001	MCCOLLUM HENRY VILLAGE	58
TX063002	HEARNE HA	60
TX063003	HEARNE HA	30
TX118	**HOUSING AUTHORITY OF THE CITY OF CALDWELL**	
TX118001	CALDWELL	40
TX168	**HOUSING AUTHORITY OF THE CITY OF DAYTON**	
TX168002	WEST CLAYTON SITE	20
UT007	**HOUSING AUTHORITY OF THE CITY OF PROVO**	
UT007005	MOUNTAIN VIEW	30
UT007006	SCATTERED SITES	25
WI045	**SHAWANO HOUSING AUTHORITY**	
WI045001	PARKSIDE APTS	80
WI045002	ELIZABETH/RICHMOND	40
WI067	**PRAIRIE DU CHIEN HOUSING AUTHORITY**	
WI067001	BLACK HAWK APTS	38
WI076	**WATERTOWN HOUSING AUTHORITY**	
WI076001	JOHNSON ARMS	79
WV014	**HOUSING AUTHORITY OF THE CITY OF BENWOOD**	
WV014001	GATEWAY APTS	61
WV014002	MARWOOD APTS	59
WV014003	MCMECHAN MANOR	37

Developments from Housing Authorities with 250 to 1,249 Units

AL166	**HOUSING AUTHORITY OF THE CITY OF CHICKASAW**	**UNITS**
AL166002	PROJECT 02	172
AL166003	PROJECT 03	70
AL189	**TOP OF ALABAMA REGIONAL HOUSING AUTHORITY**	
AL189001	HIDDEN SPRINGS	30
AL189006	GURLEY GARDENS	20
AL189008	IDER HOMES	40
AR031	**HOT SPRINGS HOUSING AUTHORITY**	
AR031001	EASTWOOD GARDENS	244
AR031002	MOUNTAIN VIEW TOWERS	135
CA023	**COUNTY OF MERCED HOUSING AUTHORITY**	
CA023001	GATEWAY HOMES	101
CA023004	LOS BANOS HOMES	40
CA023006	LIVINGSTON HOMES	60
CA024	**COUNTY OF SAN JOAQUIN HOUSING AUTH.**	
CA024001	SIERRA VISTA HOMES	394
CA024009	KRAFT HOMES	45
CA030	**TULARE COUNTY HOUSING AUTHORUITY**	**UNITS**
CA030017	PORTERVILLE	65
FL002	**HOUSING AUTHORITY OF THE CITY OF ST. PETERSBURG**	
FL002021A	JORDAN PARK	92
FL002022A	JORDAN PARK APTS	21
FL002022B	JORDAN PARK APTS	83
FL007	**HOUSING AUTHORITY OF THE CITY OF DAYTONA BEACH**	
FL007010	CAROLINE VILLAGE	100
FL007011	MALEY APTS.	150
FL007018	LAKESIDE VILLAGE	103
FL010	**HOUSING AUTHORITY OF THE CITY OF FORT LAUDERDALE**	
FL010002	DR KENNEDY HOMES	131
FL010005	SAILBOAT BEND	105
FL010007	SUNNYREACH ACRES	129
FL073	**TALLAHASSEE HOUSING AUTHORITY**	
FL073001	SPRINGFIELD APTS	184
FL073002	ORANGE AVE APTS	200
FL073006	PINEWOOD PLACE	96
IL014	HOUSING AUTHORITY FOR LASALLE COUNTY	UNITS
IL014007	Centennial Courts	51
IL014029	SCATTERED SITES	18
L018	**HOUSING AUTHORITY OF THE CITY OF ROCK ISLAND**	
IL018003	Rock Island Housing Authority	37
IL018006	Spencer Towers	199
IL061	**HOUSING AUTHORITY OF THE COUNTY OF FRANKLIN**	
IL061001	WEST FRANKFORT HOUSING	175
IL061003	ZEIGLER HOUSING	50
IL061010	ANNA GRAY HI-RISE	76
IN023	**HOUSING AUTHORITY OF THE CITY OF JEFFERSONVILLE**	
IN023002	Greentree Village	62
IN023003	GREENWOOD APTS	74
IN023006	CLARK ARMS APARTMENTS, 117 W. MARKET ST.	101
KY019	**HOUSING AUTHORITY OF MIDDLESBOROUGH**	
KY019003	SCHULTZ HEIGHTS	68
KY019005	HINKS HEIGHTS	62
KY019006	JUNCTION APARTMENTS & YOAKUM APARTMENTS	100
LA004	**HOUSING AUTHORITY OF LAKE CHARLES**	
LA004004	CARVER COURTS	88
LA005	**HOUSING AUTHORITY OF THE CITY OF LAFAYETTE**	
LA005003	MACON, CONNIE, KELLY, BOULET	100
LA005004	MARTIN LUTHER KING	73
LA005009	IRENE	92
MD018	**ANNE ARUNDEL COUNTY HOUSING AUTH.**	
MD018001	BURWOOD GARDENS	200
MD018002	MEADE VILLAGE	200
MD018005	PINEWOOD EAST	90

ME003	**PORTLAND HOUSING AUTHORITY**	**UNITS**
ME003006	HARBOR TERRACE	119
ME003008	RIVERTON PARK	141
ME003009	WASHINGTON GARDENS	100
MI039	**PORT HURON HOUSING COMMISSION**	
MI039001	HURON – GRATIOT VILLAGES	118
MI039002	DESMOND – PERU	206
MI039003	DULHUT VILLAGE	117
MN085	**AUSTIN HRA**	
MN085001	TWIN TOWERS	204
MN085003	PICKET PLACE	100
MO013	**HOUSING AUTHORITY OF THE CITY OF POPLAR BLUFF**	
MO013001	POPLAR BLUFF	180
MO013002	POPLAR BLUFF	65
MO013005	POPLAR BLUFF	76
MO188	**JOPLIN HOUSING AUTHORITY**	
MO188002	Bartlett Hills	32
MO188006	MURPHY MANOR	76
MS077	**THE HOUSING AUTHORITY OF THE CITY OF TUPELO**	
MS077001	CANAL STREET	60
MS077003	PARKHILL VILLAGE EAST	175
NC020	**HOUSING AUTHORITY OF THE CITY OF WILSON**	
NC020002	WHITFIELD HOMES	143
NC020006	FOREST ROAD HOMES	125
NC020007	EB JORDAN HOMES	114
NC021	**HOUSING AUTHORITY OF THE COUNTY OF WAKE**	
NC021003	VANCE / NORTH	32
NC021006	MASSEY APTS	90
NC021008	YOUNGWOOD / DECKER	48
NH003	**DOVER HOUSING AUTHORITY**	
NH003002	WHITTIER PARK	60
NH003006	WALDRON TOWERS	84
NH003007	ST. JOHN'S	30
NJ016	**HARRISON HOUSING AUTHORITY**	
NJ016001	HARRISON GARDENS	214
NJ016002	KINGSLAND COURTS	54
NJ037	**IRVINGTON HA**	
NJ037002	DEVELOPMENT 2	48
NJ037005	DEVELOPMENT 5	241
NJ063	**VINELAND HA**	
NJ063001	PARKVIEW	25
NJ063002	TARKLIN TERRACE	150
NJ063006	KIDSTON TOWERS	103
NY025	**WATERVLIET HOUSING AUTHORITY**	
NY025001	MICHAEL J DAY APTS	90
NY025002	ABRAM HILTON APTS	30
NY025003	QUINN APTS	61
NY042	**WHITE PLAINS HOUSING AUTHORITY**	
NY042001	LAKE VIEW HOUSE	95
NY042006	WINBROOK	450
NY070	**LOCKPORT HOUSING AUTHORITY**	
NY070002	SPIRES	97
NY070008	GABRIEL	40
NY070010	AUTUMN GARDENS	72
OR006	**HA & COMMUNITY SERVICES AGENCY OF LANE COUNTY**	
OR006002	MCKENZIE VILLAGE	172
OR006004	PARKVIEW	150
OR006007	RIVERVIEW TERRACE	60
PA004	**ALLENTOWN HOUSING AUTHORITY**	
PA004003	GROSS TOWERS	145
PA004014	SCATTERED SITE	49
PA004018	OVERLOOK PARK	79
PA043	**NANTICOKE HOUSING AUTHORITY**	
PA043002	PARK TOWERS	98
PA043003	OPLINGER TOWERS	219

Developments from Housing Authorities with 250 to 1,249 Units (Continued)

PA047	**WILKES BARRE HOUSING AUTHORITY**	**UNITS**
PA047001	LINCOLN PLAZA	200
PA047003	EAST END/SOUTH VIEW	190
PA047005	VALLEY VIEW TERRACE	202
RI006	**CRANSTON HOUSING AUTHORITY**	
RI006003	RANDALL MANOR	80
RI006005	KNIGHTSVILLE MANOR	179
RI006006	JENNINGS MANOR	51
SC003	**HOUSING AUTHORITY OF SPARTANBURG**	
SC003007	CAMMIE CLAGGETT COURT	150
SC003008	ARCHIBALD RUTLEDGE	150
SC003009	VICTORIA GARDENS APARTMENTS	80
SC023	**HOUSING AUTHORITY OF SUMTER**	
SC023002A	HARMONY/FRIENDSHIP/HAMPTON	36
SC023002B	HARMONY	164
SC023004	RAST STREET/SOUTH SUMTER	86
TN012	**LAFOLLETTE HOUSING AUTHORITY**	
TN012007	WARTBURG/WORTHAM PARK	50
TN012010	SHARP CIRCLE	70
TN012022	CK LEWALLEN	59
TN012038	LUTTRELL	50
TN014	**FAYETTEVILLE HOUSING AUTHORITY**	
TN014006	MADDEN HOMES	40
TN014011	MAYBERRY COURTS	36
TN014012	SCOTT HOMES	20

TN029	**GALLATIN HOUSING AUTHORITY**	**UNITS**
TN029003	REECE LACKEY HEIGHTS	38
TN029010	CHAFFIN HEIGHTS	53
TN029011	CLEARVIEW COURTS	100
TN038	**MORRISTOWN HOUSING AUTHORITY**	
TN038001	C FRANK DAVIS	146
TN038005	C FRANK DAVIS EXT.	200
TN038008	S.S. SURRETT HOMES	36
TN065	**MARYVILLE HOUSING AUTHORITY**	
TN065001	PARKSIDE	149
TN065003	MCGHEE TERRACE	48
TN065006	BROADWAY TOWERS	150
VA005	**HOPEWELL REDEVELOPMENT & H/A**	
VA005001	DAVISVILLE	96
VA005004	THOMAS ROLLE CT EXT	60
VA005007	PIPER SQUARE	104
VA011	**ROANOKE REDEVELOPMENT & H/A**	
VA011002	LINCOLN TERRACE	155
VA011005	HUNT MANOR	96
VA011007	JAMESTOWN PLACE	150
WI003	**MADISON COMMUNITY DEVELOPMENT AUTHORITY**	
WI003004	BJARNES	169
WI003006	BIRMINGHAM	165
WI003008	TRUAX PARK	119

Developments from Housing Authorities with 1,250 to 6,600 Units

AL001	**HOUSING AUTHORITY OF THE BIRMINGHAM DISTRICT**	**UNITS**
AL001001	ELYTON VILLAGE	360
AL001004	SOUTHTOWN	441
AL001006	CHARLES P MARKS VILLAGE	488
AL001007	LOVEMAN VILLAGE	495
AL001011	MORTON SIMPSON	123
AL001013	COLLEGEVILLE CENTER	389
AL001018	RALPH KIMBROUGH HOMES	230
AL002	**MOBILE HOUSING BOARD**	
AL002002	ORANGE GROVE HOMES	289
AL002008	JOSEPHINE ALLEN HOMES	285
AL002012	CENTRAL PLAZA TOWERS	340
CA001	**SAN FRANCISCO HSG AUTHORITY**	
CA001001	SUNNYDALE/VELASCO	767
CA001002	POTRERO TERRACE	469
CA001018A	PING YUEN NORTH	194
CA001018B	MISSION DELORES	92
CA002	**HOUSING AUTHORITY OF THE COUNTY OF LOS ANGELES**	
CA002001	CARMELITOS	706
CA002004	NUEVA MARAVILLA	496
CA002014	WEST KNOLL & PALM APTS	263
CA002015	FRANCISQUITO VILLAS	88
CA002066	WOODCREST 1	10
CA003	**OAKLAND HOUSING AUTHORITY**	**UNITS**
CA0030001 02	ADEL COURTS	30
CA0030001 05	OAKGROVE NORTH	76
CA003002	CAMPBELL VILLAS	151
CT001	**BRIDGEPORT HOUSING AUTHORITY**	
CT001002	MARINA VILLAGE	384
CT001006	CHARLES GREENE HOMES	268
CT001045	TRUMBULL GARDENS	380
FL001	**JACKSONVILLE HOUSING AUTHORITY**	
FL001013	SOUTHWIND VILLAS	244
FL001019	HOGAN CREEK TOWERS	183
FL001046	COLONIAL VILLAGE	100

FL003	**TAMPA HOUSING AUTHORITY**	**UNITS**
FL003001	NORTH BOULEVARD HOMES	517
FL003005	SHIMBERG ESTATES	78
FL003008	ROBLES PARK VILLAGE	433
FL003012	JL YOUNG GARDENS	400
GA004	**HOUSING AUTHORITY OF THE CITY OF COLUMBUS**	
GA004008	ELIZABETH HOMES	152
GA004011	GEORGE RIVERS HOMES	24
GA004019	ASHLEY HOMES	175
GA007	**HOUSING AUTHORITY OF THE CITY OF MACON**	
GA007002	TINDALL HEIGHTS	94
GA007006	FELTON HOMES	100
GA007011	MCCAFFE TOWERS	199
IL001	**THE HOUSING AUTHORITY OF CITY OF EAST ST. LOUIS**	
IL001001	SAMUEL GOMPERS	240
IL001004	ROOSEVELT HOMES	138
IL001008	LANSDOWNE TOWERS	281
IL022	**ROCKFORD HOUSING AUTHORITY**	
IL022001	BLACKHAWK COURT	196
IL022005	BREWINGTON OAK	432
IL022007	FAIRGROUNDS	210
KY001	**HA LOUISVILLE**	
KY001002	BEECHER TERRACE	760
KY001003	PARKWAY PLACE	637
LA001	**HOUSING AUTHORITY OF NEW ORLEANS**	
LA001003	IBERVILLE	819
LA006	**HOUSING AUTHORITY OF MONROE**	
LA006002	JOHNSON/CARVER	76
LA006006	BURG JONES LANE	302
LA006013	MCKEEN PLAZA	100
MA001	**LOWELL HOUSING AUTHORITY**	
MA001001	NORTH COMMON VILLAGE	450
MA006	**FALL RIVER HOUSING AUTHORITY**	
MA006001	SUNSET HILL	355
MA006003	FATHER DIAFARIO VILLAGE	224
MA006007	OLIVIERA APTS	84

Developments from Housing Authorities with 1,250 to 6,600 Units (Continued)

MA012	**WORCESTER HOUSING AUTHORITY**	**UNITS**
MA012001	GREAT BROOK VALLEY	534
MA035	**SPRINGFIELD HOUSING AUTHORITY**	
MA035001	RIVERVIEW APARTMENTS	344
MA035003	JOHN L. SULLIVAN	96
MA035013	CENTRAL APARTMENTS	44
MD004	**HOUSING OPPRTY COM OF MONTGOMERY CO**	
MD004015	ARCOLA TOWERS	141
MI001	**DETROIT HOUSING COMMISSION**	
MI001027	WARREN WEST	143
MI001028	CONNER WAVENLY/RIVERBEND	95
MI001050	BREWSTER-DOUGLAS	243
MN001	**PUBLIC HOUSING AGENCY OF THE CITY OF SAINT PAUL**	
MN001003	MT AIRY VALLEY	451
MN001018	MONTREAL HI-RISE	185
MN001027	SEAL HI-RISE	144
MN002	**MINNEAPOLIS PHA IN AND FOR THE CITY OF MINEAPOLIS**	
MN002001	GLENDALE	183
MN002030	CEDAR HIGH	190
MN002033	SPRING MANOR	188
NC002	**RALEIGH HA**	
NC002005	WALNUT TERRACE	299
NC002006	GLENWOOD	279
NC002015	CARRIAGE HOUSE	90
NC003	**HOUSING AUTHORITY OF THE CITY OF CHARLOTTE**	
NC003012	DILLEHAY COURTS	135
NC003019	PARKTOWNE TERRACE	163
NC003025	GLADE DALE	49
NE001	**OMAHA HOUSING AUTHORITY**	
NE001001	SOUTHSIDE TERRACE	354
NE001007	PARK TOWER SOUTH	115
NE001011	JACKSON TOWER	203
NJ009	**JERSEY CITY HA**	
NJ009005	HOLLAND GARDENS	189
NJ009014	THOMAS J. STEWART APTS.	44
NJ009030	CURRIES WOODS PHASE V	80
NJ015	**HOBOKEN HA**	
NJ015001	ANDREW JACKSON GARDENS	598
NY001	**SYRACUSE HOUSING AUTHORITY**	
NY001001	PIONEER HOMES	563
NY001004	CENTRAL VILLAGE	363
NY001005	TOOMEY ABBOTT TOWER	306
NY001010	VINETTE TOWERS	153
NY002	**BUFFALO MUNICIPAL HOUSING AUTHORITY**	
NY002003	COMMODORE PERRY	262
NY002008	SHAFFER VILLAGE	231
NY002010	KENFIELD HOMES	658
NY002045	FERRY GRIDER HOMES	209
NY003	**THE MUNICIPAL HSNG AUTHORITY CITY YONKERS**	
NY003004	WALSH ROAD HOMES	299
NY003009	COTTAGE PLACE	256
NY003011	SCATTERED SITE	72
NY012	**TROY HOUSING AUTHORITY**	
NY012001	CORLISS PARK	184
NY012007	MARTIN LUTHER KING	120
NY012012	GRISWOLD HEIGHTS	390
OH001	**COLUMBUS METROPOLITAN HOUSING AUTHORITY**	
OH001044	TREVITT HEIGHTS	137
OH001046	POST OAK STATION	78
OH001048	Columbus Metro HA	229
OH004	**CINCINNATI METROPOLITAN HOUSING AUTHORITY**	
OH004001	WINTON TERRACE	599

OH005	**DAYTON METROPOLITAN HOUSING AUTHORITY**	**UNITS**
OH005010	WILKINSON PLAZA	200
OH005015	RIVERVIEW	60
OH005026	GRAND AVENUE	95
OH007	**AKRON METROPOLITAN HOUSING AUTHORITY**	
OH007006	ALLEN DICKSON APTS.	103
OH007017	FRED W. NIMMER PLACE	240
OH007029	HONEY LOCUST GARDEN	125
OR002	**HOUSING AUTHORITY OF PORTLAND**	
OR002005	HILLSIDE TERRACE	60
OR002016	SELLWOOD CENTER	110
OR002042	CELILO COURT	28
PA001	**HOUSING AUTH CITY OF PITTSBURGH**	
PA001009	NORTHVIEW HEIGHTS	492
PA001015	PA – BIDWELL	120
PA001041	CALIGIURI PLAZA (ALLENTOWN)	104
PA001086	FAIRMONT APTS.	60
PA008	**HARRISBURG HOUSING AUTHORITY**	
PA008003	JOHN HALL MANOR	538
PA009	**READING HOUSING AUTHORITY**	
PA009001	GLENSIDE HOMES	400
PA009002	HENSLER HOMES	102
PA009003	OAKBROOK HOMES	525
PA009008	D EISHENHOWER APTS	156
PA009010	HUBERT APTS	70
PA019	**JOHNSTOWN HOUSING AUTHORITY**	
PA019002	OAKHURST HOMES	100
PA019004	SOLOMON HOMES	247
PA019005	VINE STREET TOWER	182
TN003	**KNOXVILLE COMMUNITY DEVEL CORP**	
TN003001	WESTERN HEIGHTS	244
TN003009	WALTER P. TAYLOR HOMES	208
TN003014	MONTGOMERY VILLAGE	217
TN005	**METROPOLITAN DEVELOPMENT & HOUSING AGENCY**	
TN005001	CAVCE PLACE	364
TN005014	EDGEHILL / GERNERT STUDIO APTS	147
TN005021	PARTHENON TOWERS	255
TX003	**HOUSING AUTHORITY OF EL PASO**	
TX003006	S HERMAN PLAZA	180
TX003019	RAFAEL MARMOLEJO	292
TX003035	EDWARD M. POOLEY APTS	139
TX005	**HOUSING AUTHORITY OF THE CITY OF HOUSTON**	
TX005002	KELLY VILLAGE	333
TX005005	IRVINGTON VILLAGE	318
TX005037	HISTORIC OAKS OF APV	278
TX006	**SAN ANTONIO HOUSING AUTHORITY**	
TX006001	ALAZAN	184
TX006018	VICTORIA PLAZA	185
TX006054	CISNEROS APARTMENTS	55
TX008	**CORPUS CHRISTI HOUSING AUTHORITY**	
TX008002	NAVARRO	210
TX008006	LA ARMADA II	300
TX008010	PARKWAY HOMES	22
VA006	**NORFOLK REDEVELOPMENT & H/A**	
VA006008	GRANDY VILLAGE	88
VA006009	TIDEWATER GARDENS	422
VA006010	YOUNG TERRACE	751
VA006020	EULALIE BOBBITT	84
VA007	**RICHMOND REDEVELOPMENT & H/A**	
VA007005	CREIGHTON CT	504
WA001	**SEATTLE HOUSING AUTHORITY**	
WA001009	JEFFERSON TERRACE	299
WA001027	CAPITAL PARK	124
WI002	**HOUSING AUTHORITY OF THE CITY OF MILWAUKEE**	
WI002002	WEST LAWN	710

Developments from Housing Authorities with More than 6,600 Units

CA004	**HOUSING AUTHORITY OF THE CITY OF LOS ANGELES**	**UNITS**
CA004001	RAMONA GARDENS	496
CA004004	RANCHO SAN PEDRO	284
CA004006	WILLIAM MEAD HOMES	413
CA004008	ROSE HILL COURTS	99
CA004013	NICKERSON GARDENS	1058
CA004016	JORDAN DOWNS	695
CA004021	MAR VISTA GARDENS	599
CA004022	SAN FERNANDO GARDENS	447
DC001	**D.C HOUSING AUTHORITY**	
DC001013	LINCOLN HEIGHTS	415
DC001023	STODDERT TERRACE	272
DC001037	GARFIELD TERRACE	279
DC001043	POTOMAC GARDENS	344
DC001068	HARVARD TOWERS	190
DC001095	COLUMBIA ROAD	23
FL005	**MIAMI-DADE HOUSING AUTHORITY**	
FL005015	ANNIE COLEMAN	143
FL005018	SMATHERS PLAZA	177
FL005026	HALEY SOFGE TOWERS	474
FL005032	RAINBOW VILLAGE	99
FL005067	LITTLE RIVER PLAZA	85
IL002	**CHICAGO HOUSING AUTHORITY**	
IL002003	BRIDGE PORT	127
IL002025	LOWEN HOMES	126
IL002028	LAKE PARC	113
IL002033	ARMOUR SQUARE	91
IL002038	TRUMBULL	453
IL002043000	ECKHART PARK	204
IL002044	FLANNERY	116
IL002050	ELIZABETH DAVIS	149
IL002052	CAMPBELL APTS	149
IL002059	SCHNEIDER APTS	162
IL002062	IRENE MCCOY	149
IL002063000	LAS AMERICAS	212
IL002067000	PATRICK SULLIVAN	443
IL002068	WICKER PARK	107
IL002072	LINCOLN / SHEFFIELD	194
IL002073	ELIZABETH WOOD	84
IL002083	JUDGE GREEN	145
IL002084	JUDGE SLATER	187
IL002102	LINCOLN	163
MA002	**BOSTON HOUSING AUTHORITY**	
MA002001	CHARLESTOWN	1252
MA002007	BROMLEY-HEATH	789
MA002014	ALICE HAYWOOD TAYLOR	363
MA002023	MARY ELLEN MCCORMACK	1016
MA002024	OLD COLONY	867
MA002047	GENERAL WARREN APTS	95
MA002113	ORCHARD GARDENS	216
MD002	**HOUSING AUTHORITY OF BALTIMORE CITY**	
MD002001	LATROBE HOMES	667
MD002003	PERKINS HOMES	630
MD002006	GILMOR HOMES	541
MD002009	O'DONNELL HEIGHTS	297
MD002011	CHERRY HILL HOMES	1281
MD002021	BROOKLYN HOMES	485
MD002046	CHASE HOUSE	189
MD002110	PLEASANT VIEW GARDENS	311
NJ002	**NEWARK HA**	
NJ002001	SETH BOYDEN	396
NJ002016	STEPHEN CRANE ELD	930
NJ002017	KRETCHMER ELDERLY	1140
NY005	**NEW YORK CITY HOUSING AUTHORITY**	
NY005000020	WILLIAMSBURG	1621
NY005000040	REDHOOK EAST	1408
NY005000050	QUEENSBRIDGE SOUTH	1602
NY005000140	INGERSOLL	1195
NY005000160	BROWNSVILLE	1332
NY005000170	JOHNSON	1191

NY005	**NEW YORK CITY HOUSING AUTHORITY (continued)**	UNITS
NY005000200	LINCOLN HOUSES	1279
NY005000210	MARCY	1716
NY005000230	WALD	1859
NY005000240	LESTER PATTERSON	1790
NY005000250	GOWANUS	1137
NY005000260	ASTORIA	1102
NY005000270	SMITH	1932
NY005000290	FARRAGUT	1394
NY005000330	WOODSIDE	1361
NY005000370	RANGEL	981
NY005000380	ST. NICHOLAS	1522
NY005000410	DYCKMAN	1167
NY005000420	TODT HILL	503
NY005000440	GLENWOOD	1189
NY005000480	RAVENSWOOD	2163
NY005000520	BERRY	506
NY005000530	POMONOK	2071
NY005000550	REDFERN	603
NY005000560	BREUKELEN	1633
NY005000570	EDENWALD	2035
NY005000580	CARVER HOUSES	1246
NY005000590	FOREST	1350
NY005000610	VAN DYKE I	1601
NY005000650	BREVORT	894
NY005000690	COOPER PARK	703
NY005000710	SOUNDVIEW	1264
NY005000720	HOWARD	814
NY005000770	MARINERS HARBOR	605
NY005000780	HIGHBRIDGE GARDENS	699
NY005000870	GRANT	1940
NY005000880	MONROE	1107
NY005000890	PINK	1500
NY005000920	BAYVIEW	1581
NY005000960	TILDEN	998
NY005001010	LEHMAN VILLAGE	619
NY005001130	BUTLER	1516
NY005001180	ADAMS HOUSES	925
NY005001210	MOTT HAVEN	996
NY005001220	LAFAYETTE	877
NY005001230	CLINTON	748
NY005001360	FULTON	937
NY005001490	POLO GROUNDS TOWERS	1614
NY005001650	BEACH 41ST ST - BEACH CHANNEL DR.	710
NY005005050	QUEENSBRIDGE NORTH	1537
NY005005140	WALT WHITMAN	1299
NY005010030	HARLEM RIVER	690
NY005010060	VLADECK	1706
NY005010080	SOUTH JAMAICA I & II	1047
NY005010090	EAST RIVER	2052
NY005010100	KINGSBOROUGH & EXTENSION	1329
NY005010130	WEST BRIGHTON	488
NY005010180	RIIS I & II	1768
NY005010220	AMSTERDAM/HARBORVIEW	1460
NY005010280	MELROSE	1241
NY005010300	KING TOWERS	1865
NY005010310	ALBANY	656
NY005010320	BRONX RIVER	1327
NY005010340	EAST CHESTER	1056
NY005010350	SOUTH BEACH (NEW LANE)	277
NY005010360	SHEEPSHEAD BAY	2199
NY005010390	PELHAM PARKWAY	1525
NY005010450	SEDGWICK	931
NY005010470	PARKSIDE	1611
NY005010600	BARUCH	2390
NY005010620	GEORGE WASHINGTON	1962
NY005010630	THROGG'S NECK	1697
NY005010640	JEFFERON HOUSES	1723
NY005010670	BRONXDALE	1724
NY005010700	CYPRESS HILLS	1440
NY005010730	SUMNER	1424
NY005010740	WAGNER	2154
NY005010750	HAMMEL	879
NY005010760	LAGUARDIA	1490

Developments from Housing Authorities with More than 6,600 Units (Continued)

NY005	**NEW YORK CITY HOUSING AUTHORITY (continued)**	**UNITS**
NY005010820	FREDERICK DOUGLAS & ADDITION	294
NY005010840	MILL BROOK & EXTENSION	1440
NY005010970	TAFT	1563
NY005010980	OCEAN BAY APARTMENTS	1724
NY005011000	SAMUEL GOMPERS	474
NY005011020	MORRIS	1883
NY005011030	WILLIAM MCKINLEY	613
NY005011170	RICHMOND TERRACE	488
NY005011310	TOMPKINS	1195
NY005011330	MURPHY	218
NY005011340	CHELSEA	676
NY005011350	ELEANOR ROOSEVELT I	1114
NY005011380	BOSTON-SECOR	536
NY005011390	STANLEY ISAACS	1321
NY005011410	WEBSTER	811
NY005011450	MITCHELL	1449
NY005011630	WYCKOFF GARDENS	1025
NY005011660	GERALD CAREY GARDENS	1220
NY005011680	HUGHES APTS	1022
NY005011690	SETH LOW	971
NY005011700	SURFSIDE GARDENS	596
NY005011720	O'DWYER GARDENS	1071
NY005011860	BLAND	399
NY005012100	ARMSTRONG	369
NY005012270	TWIN PARKS WEST SITES 1&2	239
NY005012340	TAYLOR-WYTHE HOUSES	525
NY005012430	BORINQUEN PLAZA I & II	934
NY005012470	HOPE GARDENS	298
NY005012610	UNITY PLAZA SITES 4-27	167
NY005012670	ANDREW JACKSON	1709
NY005013080	CLAREMONT GROUP IV	95
NY005013420	UNION AVE/E 163RD SITE 5 (DAVIDSON)	174
NY005015300	EAST 165TH STREET - BRYANT AVENUE	111
OH003	**CUYAHOGA METROPOLITAN HOUSING AUTHORITY**	
OH003004	WOODHILL HOMES	454
OH003015	OUTHWAITE HOMES	516
OH003016	LAKEVIEW TERRACE	429
OH003017	CRESTVIEW ESTATES	204
OH003024	WILSON APTS	273
OH003038	LANDON/WALTON	22

PA002	**PHILADELPHIA HOUSING AUTHORITY**	**UNITS**
PA002001	JAMES JOHNSON HOMES	535
PA002013	WILSON PARK	736
PA002020	SPRING GARDEN	203
PA002031	BARTAM VILLAGE	500
PA002046	HAVERFORD HOMES	24
PA002050	NORMAN BLUMBERG APTS	495
PA002152	GERMANTOWN HOUSE	133
RQ005	**PUERTO RICO PUBLIC HOUSING ADMINISTRATION**	
RQ001001	PONCE DE LEON	300
RQ001008	DR. RAMON DE LAPILA	586
RQ002007A	NEMESIO R. CANALES I	582
RQ002007B	NEMESIO R. CANALES II	544
RQ002009A	LUIS LLORENS I	823
RQ002009B	LUIS LLORENS TORRES II	856
RQ002009C	LUIS LLORENS TORRES III	888
RQ002010	VISTA HERMOSA III	300
RQ002015	LAS MARGARITAS II	329
RQ003015	ROSENDO MATIENZO CINTRON	160
RQ003016	MANUEL A. PEREZ	850
RQ003018	MANUEL ZENO GANDIA	444
RQ003032	JOSE CASTILLO MERCADO	148
RQ003081	EXT. MANUEL A. PEREZ	900
RQ003093	NARCISO VARONA	188
RQ003096	JOSE CELSO BARBOSA	235
RQ004003	FRANKLIN D ROOSEVELT	299
RQ005001	JUAN CORDERO DAVILA	506
RQ005006	LOS ROSALES	180
RQ005009	SABANA ABAJO	500
RQ005024	BERNARDINO VILLANUEVA	252
RQ005026	LOS LIRIOS	150
RQ005054	MONTE ISLENO	185
RQ005069	LOS LAURELES	226
RQ005104	LOS MURALES	214
RQ005114	COVAPONGA	504
RQ005131	JARDINES DE ORIENTE	134
RQ005167	SANTA ELENA	190
RQ005184	JARDINES DE GUAMANI	99
RQ005197	REPARTO SAN ANTONIO	60
RQ005216	SANTA CATALINA	92

Appendix B. Data Collection

This appendix describes the data collection methods used for the Study of Capital Needs in the Public and Indian Housing Program. Our analysis is based on data collected from three key sources:

- on-site physical inspections of public housing buildings and units to estimate capital needs (the sampling strategy is described in Appendix A; the method by which we assigned costs to the inspection data is described in Appendix C);
- modernization funding and other background data collected directly from public housing authorities; and
- secondary sources of data containing various housing authority-level and development-level characteristics from several HUD databases.

Data collection methods for each of these types of data are described below.

B.1. Physical Inspections

The on-site physical inspections involved collecting data from a sample of 550 properties in a nationally representative sample of 140 housing authorities across the country. Within each sampled property, condition and measurement information was collected on almost 200 systems contained within the site, buildings, and units. Approximately four buildings and four units within each site were inspected.

Following the approval of the study sample by HUD, Abt Associates Inc. and HUD notified the executive directors of selected properties of the requirements for this study. Exhibit B-1 presents the letters from HUD and Abt Associates Inc. alerting the housing authorities of this study. The physical condition of the selected properties was assessed on-site by architects and engineers from On-Site Insight, a firm based in Boston, Massachusetts that provides physical assessments and capital planning services. On-Site Insight has conducted over 5,500 capital needs assessments for a diverse array of clients in all 50 states including large and small public housing authorities, and various state agencies from Maine to California.

The purpose of the on-site physical inspections was to obtain current information on the physical condition of public housing at a level of detail sufficient to indicate the nature of physical deficiencies and the costs that would be required to remedy immediate repair needs and address existing modernization needs, as well as to estimate the ongoing accrual of physical needs over the next 20 years.

Two types of information were collected for each property to both cost immediate repair and existing modernization needs and estimate future accruals of repair and replacement costs:

- Current condition – observations on 195 site-, building-, and unit-level systems that were used in the study to estimate immediate repair needs (the cost to bring all systems up to working condition);
- Property characteristics and takeoffs – an inventory of all building and unit types, average sizes of units, typical building dimensions; and the dimensions of certain systems.

Our assessment of physical needs excluded the following three categories of expenditures:

- Modifications for accessibility for the disabled, as required by Section 504 of the Rehabilitation Act of 173, as amended;
- Measures taken to solely mitigate hazards of lead paint or asbestos; and
- Improvements for increasing energy efficiency (although if an older system is replaced, such as a heating system or appliance, it will be replaced with a newer product that is probably more energy efficient).

However, information on these expenditures was collected in the survey completed by housing authorities.

Exhibit B-1. HUD Notification Letter

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
WASHINGTON, DC 20410-5000

OFFICE OF PUBLIC AND INDIAN HOUSING

July 13, 2009

First Name Last Name
Title
Housing Authority
Address
City, State Zip

Dear First Name Last Name,

I am writing to request your cooperation in HUD's assessment of the capital needs of the nation's public housing stock. This Congressionally-mandated study is an update of *Capital Needs of the Public Housing Stock in 1998: Formula Capital Study*, and will become only the third study of its kind in the last two decades. Like the prior studies, the results will be used extensively by HUD and Congress to assess the state of the nation's public housing stock and improve public housing programs. One or more of your developments are part of a scientifically selected group of 550 public housing developments in 140 housing authorities across the nation.

HUD has contracted with Abt Associates, Inc. (Abt), a research firm based in Cambridge, MA to design the inspection protocol and analyze the results. The inspections will be conducted by On-Site-Insight (OSI), a nationally recognized firm that specializes in capital needs assessments. Both of these firms have participated in previous HUD assessments of the public housing stock, and are required by law to maintain the confidentiality of any information they collect.

A representative of Abt will contact you in the next few days to arrange a physical inspection of the selected developments as well as interviews with staff who are familiar with your capital needs. In addition, before arriving on site, the inspectors will fax a form for you to complete that requests some general information about the physical condition of the buildings and units at each of these properties.

I wish to thank you in advance for helping us in this effort to support the sustainability of public housing. If you have any additional questions, please feel free to call Harold Katsura at HUD (202) 402-3042 or Donna DeMarco at Abt (617) 349-2322.

Sincerely,

Deputy Assistant Secretary
Office of Policy, Program and Legislative Initiatives

Exhibit B-2. Abt Notification Letter

Abt Associates Inc.

July 15, 2009

First Name Last Name
Title
Housing Authority
Address
City, State Zip

Dear First Name Last Name:

Thank you for your assistance in HUD's assessment of the capital needs of the nation's public housing stock. You should have received a notification from HUD about the study in the last few days. A list of project(s) in your HA stock that have been selected for inspection is attached. Note that except in the case of some very large projects (500 or more units), we generally refer to the pre-asset management developments.

The inspections will be conducted nationwide, beginning in August 2009. A representative from On-Site-Insight (OSI) will contact you shortly to arrange an inspection of a small sample of buildings and units at the development(s). The inspector will explain in detail what is involved in each inspection and will answer any questions you may have. The OSI inspector will require your assistance in:

- Providing access to the development's site plans for information on property and building measurements; and
- Providing an escort who can provide access to the units, roofs, and basements and answer questions about the developments. An escort familiar with the mechanical and electrical aspects of the systems would be most helpful.

In addition to the physical inspections, the study requires certain descriptive information about this PHA and the sampled developments. We will collect this data through a survey which will be sent to you within the next couple of weeks. The types of information we will ask about include:

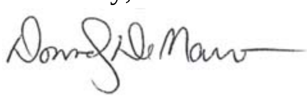
- modernization funding levels,
- allocation of resources,
- energy efficiency, accessibility, and healthy homes improvements,
- transition to asset management, and
- property specific information.

55 Wheeler Street ▪ Cambridge, Massachusetts USA ▪ 02138-1168 ▪ 617 492-7100 *telephone* ▪ 617 492-5219 *facsimile*

You may wish to delegate scheduling and logistical matters related to the inspections and/or the survey to someone else at the Authority. If so, it would be helpful to get their contact information now (you can e-mail us at CapitalNeedsStudy@abtassoc.com). Alternatively, if your administrative staff know who we should pursue matters with, they can direct OSI representatives to the appropriate personnel when they call.

If you have any additional questions, please feel free to contact Abt Associates at (617) 520-2727 or at CapitalNeedsStudy@abtassoc.com. Thank you in advance for your cooperation.

Sincerely,



Donna DeMarco
Data Collection Task Leader

List of Projects for the Prairie Du Chien Housing Authority

The list contains the old (pre-asset management) development name and number and the associated project (AMP) number for each sampled development. (Please note that in some cases the Development Name is missing.)

Project (AMP) Number	**Old Development Name**	**Old Development Number**

The Observable Systems Method

The inspections were conducted using the "observable systems" method, which is based on visual inspection and rating of each system's physical condition. The Observable Systems Approach relies on inspections of a *sample* of units and buildings at a nationally representative sample of developments and uses these data to estimate needs for the public housing stock as a whole and for various subgroups of public housing authorities.

The main advantage of this approach is that it relies on discrete, repeatable observations by trained inspectors within an established data collection system, without performing destructive testing. This approach also provides a sound basis for a comprehensive and consistent assessment of all properties that will be inspected.

The observable system inspection protocols used in this study were initially developed for the Modernization Needs Study in 1985, which inspected public housing developments.[10] The protocols were subsequently tailored for private housing stock, and refined based on experience in the field, for the Multifamily Stock study. The forms were again refined for the 1998 Public Housing Capital Needs Study, and more recently for work done by the inspection subcontractor, On-Site Insight, for their work in the private and public housing stocks. On-Site-Insight's current forms and inspection protocols were updated for this study to reflect the current public housing stock.

A "system" is defined as a quantifiable component of the site, building exterior, mechanical and electrical devices, building interior, or specialty item. At each property, inspectors gathered information on general property characteristics, current physical condition, current age, remaining life, and estimated useful life for each system. This information was used to project future costs that the property may incur.

To understand the characteristics of each system beyond what is recorded in existing materials, and what can be observed, On-Site Insight required that the inspector be accompanied by a knowledgeable maintenance staff member at each development to benefit from their input and perspective.

After evaluating each system, the inspector determined and recorded the action level needed to restore the system to its optimal condition. To ensure consistent analysis, the inspector chose among predetermined action levels, each of which corresponds to a specific set of repairs for that system.

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[10] Dixon Bain et al., Study of the Modernization Needs of the Public and Indian Housing Stock (Cambridge, MA: Abt Associates Inc., March 1988); James Wallace et al., Current Status of HUD-Insured (or Held) Multifamily Rental Housing (HUD, PD&R 1993); Judie Feins et al., Viability Review for Physical Improvements for the San Francisco Housing Authority (Cambridge, MA: Abt Associates Inc., September 1991); Meryl Finkel et al., Status of HUD-Insured (or Held) Multifamily Rental Housing in 1995 (Cambridge, MA: Abt Associates Inc., December 1998). Details on the precise protocols and forms used for the current study are provided in the HUD Formula Capital Study Inspector's Manual, (Abt Associates Inc., January 1998).

The action levels for each system are associated with specific regionalized costs. Small defects that could be corrected through routine maintenance (i.e. replacing faucet washers) were excluded from inspections. Beyond determining an action level, some systems required a specification of materials or size (recorded as "type"). For example, with bathroom floors it is necessary to specify the type of flooring material because replacing a ceramic tile floor would be more costly than replacing a resilient tile one. Other systems require system age or counts of items in order to calculate the repair costs.

Inspection Protocol

The inspection protocol included observing conditions of nearly 300, electrical, and architectural systems. See Appendix C for a list of these systems. For each system, the inspector judged and recorded the level of remedial action needed to restore the system to its original condition. The action levels were "No Action," "Minor Action," "Moderate Action," "Major Action," and "Replace," based on the observed condition. Minor defects that could be corrected through routine maintenance (e.g., faucet washer replacement) were excluded. For example, with roof covering systems, the **"Moderate"** action is repairing 20 percent of the roof area, while the **"Major"** action calls for resurfacing over existing roof covering. **"Replacement"** requires removing the entire structure including insulation and installing a new roof and installation.

The On-Site Insight inspectors used a standard set of six inspection booklets—Site, Building Architecture, Building Mechanical and Electrical, Mechanical Room, Dwelling Unit, and Inspection Building and Unit Type Form—to collect all relevant system-level information. For each observable system, the inspector noted presence or absence of the system; age; type, if appropriate (e.g., battery or hard-wired smoke detectors); number, if appropriate (e.g., the number of windows); and the repair action level associated with the observed condition, remaining life, and estimated useful life.

A detailed Inspection Manual was developed to describe each system and the repair actions pertaining to each system. For each system, the manual defines the system, explains where and how to observe the system, and then describes the repair needs associated with each action level. The manual noted the estimated useful life of all the systems and also contained exhibits of some of the systems.

The action levels assigned to each observable condition were provided to all inspectors during a three day training session in Cambridge which included both classroom training and hands-on training. The classroom training included a complete review of the systems and the different levels of repair action, as well as the proper protocol to follow during the inspections. The training also included general procedures for setting up the inspection, dealing with housing authority staff, and conducting a quality review of the forms before submitting them to Abt. The hands-on training involved teams of inspectors going on-site to several of Cambridge's public housing developments to actually conduct the inspection under the guidance of a senior inspector experienced in the Observable Systems methodology.

During the hands-on session inspectors went over key elements of the inspection forms with particular attention to the rating systems in order to assure consistency and accuracy of measurements.

The comprehensive training and uniform set of instructions helped to assure consistency across individual inspectors. Exhibits B-3 and B-4 are samples of an inspection booklet and the corresponding action level description from the Inspection Manual. The examples are taken from a section of the “Unit” booklet. (Exhibit B-3 is a page from that booklet.) Under the section labeled “Full Bathrooms” are the seven systems observed in the bathroom inspection. Some systems (walls and ceilings, accessories) require only an action level in order to estimate repair cost; others require a type (e.g., the materials in use, or size), as well as an action level for the repair estimate. For example, under the Bathroom Floor Cover and Sub-base System, “Type” is necessary because replacing a *ceramic* tile floor would be more costly than replacing a *resilient* tile floor or linoleum. Exhibit B-4 is taken from the Inspection Manual of conditions and action levels.

Exhibit B-3. Page from Inspection Form

			NP	NA	MIN	MOD	MAJ	REP	CODE	AGE	RL	EUL			NOTES
DOORS															
Hallway	Type:														
Interior	Type:														
Closet	Type:														
Closet	Type:														
LIVING AREA															
Walls	Part:	Surf:											%		
Ceilings	Part:	Surf:											%		
Floors	Type:												%		
Smoke Detector															Hardwired / Battery
Heat Detector															Hardwired / Battery
Sprinkler Heads															
HALLWAY/STAIRS															
Walls	Part:	Surf:											%		
Ceilings	Part:	Surf:											%		
Floors	Type:												%		
Stairs	Type:	Size:													
KITCHEN															**Entry/88**
Walls	Part:	Surf:											%		
Ceilings	Part:	Surf:											%		
Floors	Type:												%		
Cabinet	LF:														
Countertop/Sink/Faucet															
Disposal															
Dishwasher															
Range	Gas/Electric														
Rangehood															Vented / Recirculating
Refrigerator															
Laundry Facilities															
GFCI															
BEDROOM #1															
Walls	Part:	Surf:											%		
Ceilings	Part:	Surf:											%		
Floors	Type:												%		
BEDROOM #2															
Walls	Part:	Surf:											%		
Ceilings	Part:	Surf:											%		
Floors	Type:												%		
BEDROOM #3															
Walls	Part:	Surf:											%		
Ceilings	Part:	Surf:											%		
Floors	Type:												%		

Exhibit B-3. Page from Inspection Form *(Continued)*

	NP	NA	MIN	MOD	MAJ	REP	CODE	AGE	RL	EUL	NOTES
BATHROOM #1											**Entry/88**
Walls Part: Surf:											%
Ceilings Part: Surf:											%
Floors Type:											%
Fixtures - Tubs Type:											Mixing Valve Y / N
Fixtures - Toilets											
Fixtures - Sinks											
Vanity											
Vent & Exhaust											
Accessories/Grab Bars											
BATHROOM #2											
Walls Part: Surf:											%
Ceilings Part: Surf:											%
Floors Type:											%
Fixtures - Tubs Type:											Mixing Valve Y / N
Fixtures - Toilet											
Fixtures - Sink											
Vanity											
Vent & Exhaust											
Accessories/Grab Bars											
UNIT HVAC											
Radiation Type:											
Temperature Controls											Type:
Local HVAC Unit											Type:
Unit AC											Type:
DHW Heater											Type: Size:
Warm Air Furnace										25	Type:
Boiler										25	
UNIT ELECTRICAL											**Entry/88**
Intercom/Buzzer											
ECAS											
Electrical Panel											Elec. Heat: Y / N
Wiring											Type: Size:
BEDROOM #4											
Walls Part: Surf:											%
Ceilings Part: Surf:											%
Floors Type:											%
BEDROOM #5											
Walls Part: Surf:											%
Ceilings Part: Surf:											%
Floors Type:											%

Exhibit B-4. Corresponding Page from Inspection Manual

DU

KITCHEN CABINET

OBSERVED CONDITION	ACTION LEVEL	TYPICAL ACTION
N/A	PM (L)	N/A
N/A	PM ($)	N/A
Drawers off track, cabinet doors do not close properly	MINOR	Repair drawers, replace door hinges
Cabinet paint peeling, minor holes and nicks	MODERATE	Refinish existing cabinets
N/A	MAJOR	N/A
Water, fire or vandalism damage to cabinet base; majority of doors and drawers missing or broken, cabinet base has lost integrity	REPLACE	Remove and replace cabinet system **FAM EUL = 20** **ELD EUL = 25**

 DU-10

ON·SITE INSIGHT
A Recap Advisors Company

Exhibit B-4. Corresponding Page from Inspection Manual *(Continued)*

DU

BATHROOM FIXTURES

Components	Types
*Tub	1. Porcelain Tub
*Toilet	2. Fiberglass Tub
*Sink	

OBSERVED CONDITION	ACTION LEVEL	TYPICAL ACTION
Surveillance	PM (L)	Open/close shut-off valves, grout
All plumbing fixtures intact, but one fitting is broken or non-functional	PM ($)	Install one new fitting on lavatory or bathtub (includes new shower head)
Sink is chipped, rusted, cracked or generally deteriorated	MINOR	Replace sink
Toilet chipped, rusted, cracked or generally deteriorated	MODERATE	Replace toilet
Sink and toilet or tub is chipped, rusted, cracked or deteriorated	MAJOR	Replace sink and toilet, or replace tub
All fixtures are chipped, rusted, cracked or generally deteriorated	REPLACE	Replace all fixtures **EUL = 20**

Using architectural drawings, when available, or "pacing off" when no plans were available, the inspectors calculated takeoff measurements for site areas and distribution systems, average unit square footage for all unit sizes present at the property, and key building dimensions for up to four predominant types/sizes of buildings. These measurements were recorded on the corresponding form. For example, measurement for room sizes are contained in the "Unit" form, and measurements for site systems (gross area, parking areas, landscaping) are contained on the "Site" form.

In advance of the inspector's visit, On-Site Insight sent an Inspection Building and Unit Type Form (IBUT) to the property manager. This form was used to obtain overall descriptions of the development stock and to guide the selection of buildings and units to inspect. The IBUT Form is presented in Exhibit B-5.

The manager completed the information on the number of units by size (bedrooms and bathrooms), as well as the number of buildings by type (high-rise, walk-up, garden/townhouse, single-family detached). When the inspectors arrived on-site, they reviewed the IBUT Form with the property manager and discussed the general characteristics of the property, including:

- Number, type (high-rise, walk-up, etc.), and age of buildings; and
- Number of units by bedroom and bathroom size.

Exhibit B-5. IBUT Form

Consolidated Inspection Building and Unit Type (C-IBUT) Form

PHA Name: ___________

Development Name: ____

HUD Development No. __

Only complete this form if it is not possible to fill in the full IBUT form.
Complete one line per building type in the development. For example, if there are 125 row-houses in a development, info for them will be consolidated into one line.
Only include buildings that are on-line.
For each unit type, indicate the total number of occupied (Occ), vacant (Vac) and off-line units.

The abbreviations for "Building Type" are:

- HR – High Rise/Elevator Structure
- WU – Walk-up/Multi-family Apartment
- RW – Row/Townhouse Dwelling
- SF – Single Family Detached and Semi-detached
- CB – Common Building

	Number of Buildings	Average Age	Building Type	Unit Types (BR=Bedroom, Occ=Occupied, Vac=Vacant)														
				0 BR			1 BR			2 BR			3+ BR			TOTAL		
			HR WU RW SF C (Circle One)	Occ	Vac	Off-line	Occ	Vac	Off-line	Occ	Vac	Off-line	Occ	Vac	Off-line	Occ	Vac	Off-line
1)			HR_ WU RW SF CB															
2)			HR WU RW SF CB															
3)			HR WU RW SF CB															
4)			HR WU RW SF CB															
5)			HR WU RW SF CB															
Total																		

B.2. Data Collected from Housing Authorities

To obtain data on past and planned modernization spending from the housing authorities, we developed data abstraction surveys for housing-authority level (Exhibit B-6, which appears at the end of this chapter) and development level data, which were sent to all housing authorities in the study. Most of the data requested was of the type reported in the PHA Five-Year and current year Capital Fund Plans or Capital Fund Financing Program Plan if applicable. Whenever possible the form referred to specific elements in the plans, so that housing authorities could either attach the relevant part of that documentation or complete the form. Data was requested at the housing authority level as well as at the development level for the developments in our study.

The data elements we requested at the housing authority level were:

- Number of units covered by various funding sources (e.g., federal public housing, Housing Choice Vouchers, HAP Contracts, state-funded public housing, USDA rural rental housing program)
- Number of designated family and elderly/disabled units
- Number of units removed from the Annual Contributions Contract (ACC), pending removal and pending demolition within the recently completed PHA fiscal year
- Special arrangements governing the housing authority (e.g., mixed-finance properties, private management, HUD receivership, participation in Moving to Work and Capital Fund Financing Program (CFFP))
- Percent of family and elderly/disabled units that are marketable in their current configuration and for those unmarketable, percent of units that should be repaired, upgraded, reconfigured, or demolished and not replaced
- Number of ACC units upgraded and reconfigured to improve marketability within the last three years and cost of upgrades and reconfigures
- Participation in the Capital Fund Financing Program
- Estimated funding PHAs expect to receive to support public housing capital needs over the next five fiscal years, by source of funding and total
- Planned capital improvement expenditures over the next five fiscal years, by spending categories and total
- Modernization funding expended in fiscal years 2006 and 2007, by spending category and total
- Number of public housing units accessible under Uniform Federal Accessibility Standards (UFAS), estimated total expenditures for accessibility modifications over the last three years, per unit accessibility modification cost by unit size and type of modification, and projected accessibility modification expenditures for the next five years
- Percentage of public housing units that have undergone lead removal and average cost per unit for lead removal

- Percent of public housing units that have received energy upgrades by type of upgrade, average cost per unit of energy upgrades, and estimated energy cost savings due to upgrade

We also requested development-level data for each of the developments slated to be inspected at that housing authority. The data elements requested were:

- Special arrangements governing the development (e.g., mixed-finance properties, private or residential management, participation in Capital Fund Financing Program (CFFP), energy savings performance contracts, approved or proposed demolition).
- Percent of units that are marketable in their current configuration and for those unmarketable, percent of units that should be repaired, upgraded, reconfigured, or demolished and not replaced.
- Number of units planned to be modernized over the next five years.
- Number of units planned to be demolished over the next five years.
- Number of units to be added over the next five years.
- Number of units to remain as is over the next five years.
- Lead abatement expenditures, most recent year and last three years.
- Accessibility improvement expenditures, most recent year and last three years.
- Energy upgrade expenditures, most recent year and last three years.
- Capital fund grant money received in fiscal year 2007.
- Capital fund grant money expended in fiscal years 2005, 2006, and 2007.
- Total estimated modernization funding planned for the next five years.
- Modernization funding expended over the last 10 years (between 1998 and 2007), by spending category.
- Number of units offline and vacancies.
- We also asked PHAs to provide additional documents related to capital needs spending, as applicable, to verify survey responses. The following additional documents were requested:
  - Capital Fund Financing Program Plan;
  - Copies of the latest physical needs assessments for the sampled properties;
  - Copies of the annual budget (or at a minimum, an overview of revenue and expenditures) for the entire agency (as provided in the current-year and five-year Capital Fund plans);
  - A listing of PIC development numbers for any mixed-finance properties; and
  - Copies of any recent energy audits.

We requested information from all of the housing authorities in the overall study sample. The sample consisted of 549 developments in 140 housing authorities. We received data from 116 housing authorities, covering information on 329 developments. This represents an 83 percent response rate for housing authorities and a 60 percent response rate with respect to developments.

The PHA survey data collection spanned approximately six months, beginning in September 2009. An Abt researcher was assigned to each sampled housing authority to help the agency complete the surveys and respond to any questions. Abt researchers contacted the PHA, provided information about the study and data collection instruments, assisted the PHA in completing the surveys as necessary, and followed up with non-responding agencies. The agency-wide and development-level surveys were sent electronically to each sampled housing authority at the time the on-site physical inspections were scheduled by On-site Insight. The staggered approach allowed the Abt researchers ample time to assist their assigned PHAs in completing the data collection forms.

Quality control measures were employed during all stages of the data collection process. As surveys were returned and reviewed, Abt research staff entered the data into an Access database for data analysis. All returned surveys were reviewed for completeness and consistency. The quality of data provided by the housing authorities varied greatly. In some cases, the data items were either left blank or contained numbers that appeared to be incorrect or inconsistent. In these cases, Abt staff followed up with the housing authority contact to confirm the accuracy of the responses and to complete missing responses.

Following the data collection period, Abt programmers ran univariate statistics on all survey responses and reviewed for internal consistency and plausible ranges of survey responses. For any outlying responses that were out of the plausible ranges, Abt project staff consulted hard-copy data collection forms and additional documents submitted by PHAs. If problems were not resolved, Abt staff requested clarification on the outlying responses from the agency. Every effort was made by staff to ensure the data collected was complete and accurate.

B.3. Secondary Data

There were three sources of secondary data used for this study. They include the following:

- Property data;
- Cost data; and
- Location Adjustment Index.

Property Data for Universe Definition and Sampling. Several development-level data files provided by HUD were used to identify the current universe of public housing properties. Key data elements included the count of units, flags for units with proposed/approved demolition plans, completed demolitions/dispositions, and approved HOPE VI implementation grants.

Cost Data. In order to use the data on conditions observed during the physical inspections to estimate capital needs, we developed a cost file that provides a repair cost estimate for each system based on its construction material type and size category. As in the other recent studies of capital needs, the cost estimation firm of A.M. Forgerty and Associates assisted in developing the cost file. The cost elements include all parts, labor, and contractor fees for modernization. Costs do not include mark-ups for general conditions, overhead, contingency, profit, soft-costs, or PHA management expenses.

Location Adjustment Index. The item repair and replacement costs created by A.M. Fogarty and Associates were based on national averages. The study team used the R.S. Means "Location Factors" (R.S. Means index) published in the 2008 version of the Means Square Foot Costs Book to adjust the Fogarty cost elements to reflect local price differences. The M.S. Means index is published by 3-digit ZIP code. For the purpose of this study, we used the "total" column of the index table.

B.4. Quality Control and Data Cleaning

Quality control measures were incorporated during all stages of the data collection process. For example, the inspection forms and the survey used to collect data from the housing authorities were carefully designed to ensure that they obtained the necessary information in a consistent and accurate manner. The instruments were developed with input from HUD's Office of Public and Indian Housing (PIH) staff, and the capital needs inspection firm, On-Site-Insight. The study design and instruments were also reviewed by the Study Group created specifically for this project. The Study Group consists of individuals and organizations interested in the findings of this study.

The entire set of data collection instruments—both on-site inspection forms and the survey—were pretested at two different types of developments at each of three housing authorities. The pre-test sites included Alexandria Virginia, Athens, Georgia, and Providence, Rhode Island. The pretest encompassed every step of the process—from inspection through costing reports. As each pretest was completed, instruments were revised as necessary before the next pretest. This enabled the project team to make any procedural changes determined to be necessary to improve the process or the quality of the data collected.

Experienced inspectors from On-Site Insight participated in three days of training in Cambridge to ensure a complete understanding of the Observable Systems methodology and the protocols to use during the inspection. The training included a review of each form type, sampling protocols, and a field trip to a few developments from the Cambridge Housing Authority to run through the inspection process from start to finish. Inspectors were instructed on how to record take-off information and repair conditions, note key descriptive information (make/model, signs of deferred maintenance, resident impacts), and decipher the age of any given system. The training helped to ensure that all inspectors were using the same process to rate the condition of the systems observed and recording the data in a consistent manner.

Following the inspection, the completed inspection forms were first reviewed by a senior On-Site Insight staff member, and then by coding staff at Abt Associates Inc. to identify any missing information, apparent errors, or inconsistencies in the data. All problems were then resolved through consultation with the inspector.

In addition to the quality control measures mentioned above, for each data collection component of this study Abt Associates Inc. staff did extensive data cleaning for completeness and consistency of the data. After the data was entered and available in an electronic format, a multi-stage data cleaning process was performed, testing for internal consistency and checking for plausible ranges. Problems with the inspection data were resolved by consulting the hard-copy inspection forms and requesting clarification from the inspectors. Problems with the survey data were resolved by consulting the hard-copy survey or requesting clarification from the housing authority staff. Any out-of-range values in the inspection data or the survey data were looked up and re-verified. In conjunction with the cleaning described above, a senior Abt programmer developed more sophisticated cross-form checks to identify unexpected conditions and other inconsistencies in the data.

Finally, for each data collection component, a quality control check on at least ten percent of the work was conducted. This quality control check included repeating ten percent of the physical needs inspections, as well as 100 percent verification on all data entry tasks. For inspections, ten percent of the properties (55 properties) were re-inspected by a senior member of On-Site Insight staff. Following the re-inspection, the inspection forms were compared and feedback was given to the inspector.

Exhibit B-6.

HUD Capital Needs Study
Housing Agency Background Data Form

Overview of this form:
The questions on this data form will provide essential information on this agency. Many of the items are reported to HUD under the Capital Fund program. To assist you in completing this form, please have the following documents handy. Also please forward us copies of these documents with your completed survey:

- ✓ Capital Fund Financing Program plan, if applicable;
- ✓ Copies of the latest physical needs assessments for the sampled properties;
- ✓ Copies of the annual budget (or, at a minimum, an overview of revenue and expenditures) for the entire Housing Agency (as provided in the current-year and five-year Capital Fund program plans);
- ✓ A listing of the PIC development numbers for any mixed-finance properties; and
- ✓ Copies of any recent energy audits, if applicable.

Instructions for completing this form:
This forms asks you to provide data in several ways. Many of the questions are designed for you to simply select the response that best indicates your response. These questions are typically identified by the box to the far right or the response (as in Q1b). In other questions, you will be asked to provide a numeric response to indicate how many, how much, or what proportion. These questions are identified because there is typically a line for you to record your answer on (as in Q5, Q12, or Q12e). Finally, other questions will ask for you to describe a process, or an experience, or provide some other form of written response. These questions typically include a series of lines for you to write your response (as in Q1., Q11f, and Q55a).

Some general guidelines to follow when completing this form are as follows:

- *If you see the responses with a box (❑), please check the appropriate response, or responses.*
- *If you see the responses with #_________, please record the correct dollar amount.*
- *If you see the responses with $_________, please record the correct dollar amount.*
- *If you see the responses formatted with ____________%, please indicate the response in numeric percentages and be sure that they total to 100%.*
- *If you see a series of lines or are asked to describe something, please record your written response.*
- If you would like to provide written responses **electronically**, you can use the supplemental response form. It is provided as a Microsoft word document. Simply identify the question number you wish to enter a response for in the table. In the second column, you may type your response.

A staff person from Abt Associates will call you within the next few days to ensure that you received this form and to answer any questions. If there is someone else we should contact to complete this survey within your organization, please let us know. You can send an email with the name, phone number, and email address for the alternate contact person to CapitalNeedsStudy@abtassoc.com.

In the meantime, should you have any questions or difficulty completing this form, please contact Abt Associates at (617) 520-2727 or at CapitalNeedsStudy@abtassoc.com.

Submitting the Form

Please print this form and complete it within the next two weeks. Once completed, please make a photocopy to keep for your own records. Please put the original completed form, along with the following documents:

- ✓ Capital Fund Financing Program plan (CFFP), if applicable;
- ✓ Copies of the latest physical needs assessments for the sampled properties;
- ✓ Copies of the annual budget (or, at a minimum, an overview of revenue and expenditures) for the entire Housing Agency (as provided in the current-year and five-year Capital Fund program plans);
- ✓ A listing of the PIC development numbers for any mixed-finance properties; and
- ✓ Copies of any recent energy audits, if applicable;

in an envelope and return by mail to:

«Interviewer»
Abt Associates Inc.
«Interviewer_Address»

You may also scan your completed form and the other above documents and return it via email to CapitalNeedsStudy@abtassoc.com. Thank you in advance for your assistance with this study.

A. Housing Agency Characteristics

This first section captures information about your agency.

1. Please record the name of this HA: «Housing_Authority_Name» ____________________________

   1a. Please record the Housing Authority Code: «PHA_Code» ____________________________

   1b. Please indicate the time period that best describes the PHA Fiscal Year:

   Jan-Dec .... ❑
   April-Mar .... ❑
   July-June .... ❑
   Oct-Sept .... ❑

2. Please record the name and title of person to contact with questions about this form:

   Name: _

   Title: __

3. Please record your phone #: (_____)______________________

   3a. Please provide your email address:
   ________________________ @ _________________ . ________

4. Please record the names, titles and contact information of other people who helped to complete this form:

Name:	
Title:	
Address:	
Phone #:	
Email:	
Name:	
Title:	
Address:	
Phone #:	
Email:	
Name:	
Title:	
Address:	
Phone #:	
Email:	
Name:	
Title:	
Address:	
Phone #:	
Email:	

5. For the most recently completed PHA fiscal year, please specify the number of units the HA had for each program listed. If this HA did not receive funding from the listed sources, check "Does Not Apply."

Funding Source	Number of Units Covered by Program	CHECK HERE IF Does Not Apply
Public Housing	#________	❑
Housing Choice Vouchers (formerly Section 8 vouchers and certificates)	#________	❑
HAP Contracts (Project Based Vouchers)	#________	❑
Tax Credit Properties	#________	❑
Other HUD Housing	#________	❑
State-funded public housing programs	#________	❑
State tenant-based assistance	#________	❑
Locally funded housing programs	#________	❑
USDA rural rental housing program (formerly FmHA)	#________	❑
Other (Specify:____)	#________	❑

6. For the most recently completed PHA fiscal year, please record the total number of low-income, public housing rental ACC units in the HA's portfolio, by type, on the lines below. The number of family units plus the number of elderly/disabled units should equal your PHAs total number of public housing units:

Number of designated Family Units ....#__________

Number of designated Elderly/Disabled Units ....#__________

6a. During the most recently completed PHA fiscal year, what was the total number of low-income, public housing rental units removed from the ACC?

Number of ACC Units Removed..#__________

If none, check here:..❑

6b. During the most recently completed PHA fiscal year, what was the total number of low-income, public housing rental ACC units approved for demolition? Do not include any units pending approval.

Number of ACC Units Approved for Demolition ....#__________

If none, check here:..❑

6c. Are there any pending applications for low-income, public housing rental units to be removed from the ACC in the future?

Yes .... ❑1
No .... ❑2 **(SKIP TO Q7)**
Don't Know .... ❑-1 **(SKIP TO Q7)**

6d. How many low-income, public housing rental units are covered by the pending applications?

Number of Units Pending .... #__________
Don't Know .... ❑-1

7. For each building type listed below, how many units were removed from the ACC during the most recent PHA fiscal year or are pending removal? If none, enter "zero." (Note: The sum of Q.7a, Q.7b, Q.7c, and Q.7d should equal the answer in Q.6a.)

BUILDING TYPE		# OF UNITS REMOVED/ PENDING REMOVAL	CHECK HERE IF BUILDING TYPE NOT APPLICABLE	CHECK HERE IF DON'T KNOW
7a.	Detached/Semi-detached (single-family)	_______	❑-2	❑-1
7b.	High-rise with elevator	_______	❑-2	❑-1
7c.	Rowhouse/Townhouse	_______	❑-2	❑-1
7d.	Low-rise (walk-up)	_______	❑-2	❑-1

8. How many designated family or elderly/disabled units were removed from the ACC during the most recent PHA fiscal year or are pending removal? If none, enter "zero." (Note: The sum of Q.8a andQ.8b should equal the answer in Q.6a.)

		# OF UNITS REMOVED/ PENDING REMOVAL	CHECK HERE IF UNIT TYPE NOT APPLICABLE	CHECK HERE IF DON'T KNOW
8a.	Family	______	❑-2	❑-1
8b.	Elderly/disabled	______	❑-2	❑-1

9. For each of the following bedroom types, how many units were removed from the ACC during the most recent PHA fiscal year or are pending removal? If none, enter "zero." (Note: The sum of Q.9a, Q.9b, Q.9c, and Q.9d should equal the answer in Q.6a.)

		# OF UNITS REMOVED/ PENDING REMOVAL	CHECK HERE IF UNIT TYPE NOT APPLICABLE	CHECK HERE IF DON'T KNOW
9a.	0BR	______	❑-2	❑-1
9b.	1BR	______	❑-2	❑-1
9c.	2BR	______	❑-2	❑-1
9d.	3BR +	______	❑-2	❑-1

10. Does this HA operate any mixed-finance properties?

Yes ....❑1
No..❑2 **(SKIP TO Q.11)**
Don't Know.. ❑-1 **(SKIP TO Q.11)**

10a. How many mixed-finance properties (amps) are in the HA's portfolio?

Number of mixed-finance properties ....#__________
Don't Know.. ❑-1

10b. In total, how many ACC units are in the mixed-finance properties in the HA's portfolio?

Number of ACC units in mixed-finance properties............................#__________
Don't Know.. ❑-1

11. Is this HA's ACC currently subject to any of the following special arrangements? Please check the appropriate response.

		YES	NO	DON'T KNOW
11a.	Private management (modernization only)	❑1	❑2	❑-1
	If 11a=NO: Are any properties subject to private management for modernization only	❑1	❑2	❑-1
11b.	Private management (overall)	❑1	❑2	❑-1
	If 11b=NO: Are any properties subject to private management (overall)	❑1	❑2	❑-1
11c.	Receivership or HUD takeover	❑1	❑2	❑-1
11d.	Moving to Work (MTW)	❑1	❑2	❑-1
11e.	Capital Fund Financing Program (CFFP)	❑1	❑2	❑-1
11f.	Other Special Arrangements (Specify:________________________________)	❑1	❑2	❑-1

12. Thinking only about the HA's current ACC **family** units, and how marketable they are to the low-income, public housing market in their current configuration. Please record the proportion of the HA's current ACC ***family*** units fit into each category on the corresponding line:

Marketable to low-income public housing market in current configuration ______% **(IF 100% SKIP TO 12b)**

Unmarketable because…

Repair costs are too high to pay at this time and unit is uninhabitable ______%

Current unit configuration does not work (no demand for this size, building type, or layout) ______%

Unmarketable for some other reason (Specify: ____) ______%

TOTAL 100%

Don't Know... ❑-1

12a. Think about the proportion of ***family*** units that are ***not marketable*** in their current condition to the low-income, public housing market. Using capital funds (if funds are available), please record what proportion would fall into each of the categories below:

Should be repaired in their current building	______%
Should be upgraded in their current building	______%
Should be reconfigured in their current building	______%
Should be upgraded or reconfigured by tearing down the current building(s) and rebuilding on the current site	______%
Should be upgraded or reconfigured by tearing down the current building(s) and replacing the building(s) on a different site	______%
Should be torn down and not replaced (housing not needed)	______%
TOTAL	100%

12b. Over the past 3 years, how many family units did your agency upgrade to improve marketability?

Number of family units upgraded over past 3 years ....#________________

Don't Know...❑-1

12c. Over the past 3 years, how much did the HA spend on upgrading family units to improve marketability? Please provide the amount of expenditures paid on the line below.

Expenditures for upgrading family units in past 3 years ....$_____________

Don't Know...❑-1

12d. Over the past 3 years, how many family units did you reconfigure to improve marketability?

Number of family units reconfigured over past 3 years ....#________________

Don't Know...❑-1

12e. Over the past 3 years, how much did the HA spend on reconfiguring family units to improve marketability?

Expenditures for reconfiguring family units in past 3 years ....$_____________

Don't Know...❑-1

13. Thinking only about the HA's current ACC elderly/disabled units, and how marketable they are to the low-income, public housing market in their current configuration. Please record proportion of the HA's current ACC ***elderly/disabled*** units fit into each category below:

Marketable to low-income public housing market in current configuration	______% **(IF 100% SKIP TO 13b)**
Unmarketable because…	
Repair costs are too high to pay at this time and unit is uninhabitable	______%
Current unit configuration does not work (no demand for this size, building type, or layout)	______%
Unmarketable for some other reason (Specify: ____)	______%
TOTAL	100%

Don't Know...-1

13a. Think about the proportion of ***elderly/disabled*** units that are ***not marketable*** in their current condition to the low-income, public housing market. Using capital funds (if funds are available), please record proportion of the HA's current ACC ***elderly/disabled*** units fit into each category below:

Should be repaired in their current building	______%
Should be upgraded in their current building	______%
Should be reconfigured in their current building	______%
Should be upgraded or reconfigured by tearing down the current building(s) and rebuilding on the current site	______%
Should be upgraded or reconfigured by tearing down the current building(s) and replacing the building(s) on a different site	______%
Should be torn down and not replaced	______%
TOTAL	100%

13b. Over the past 3 years, how many elderly/disabled units did your agency upgrade to improve marketability?

Number of elderly/disabled units upgraded over past 3 years #_______________

Don't Know..❑-1

13c. Over the past 3 years, how much did the HA spend on upgrading elderly/disabled units to improve marketability?

Expenditures for upgrading elderly/disabled units in past 3 years $____________

Don't Know...❑-1

13d. Over the past 3 years, how many elderly/disabled units did you reconfigure to improve marketability?

Number of elderly/disabled units reconfigured over past 3 years #_______________

Don't Know...❑-1

13e. Over the past 3 years, how much did the HA spend on reconfiguring elderly/disabled units to improve marketability?

Expenditures for reconfiguring elderly/disabled units in past 3 years $____________

Don't Know...❑-1

14. Thinking about the information you receive from your annual REAC physical inspections, do you use this information to help you determine how to allocate your capital funds?

Yes ....❑1

No...❑2 **(SKIP TO Q15)**

Don't Know...❑-1 **(SKIP TO Q15)**

14a. How do you use the information you receive from your REAC physical inspections to help you in determining how to allocate your capital funds? [Please note, if you prefer to type your response, please enter the information into the electronic supplement form]

____

____

____

____

B. Plans and Financing for Capital Needs

This next set of questions focus on your agency's plans and financing to address capital needs.

15. Does the HA have a Capital Fund Financing Program (CFFP) plan in place?

Yes ❑1
No ❑2 **(SKIP TO Q16)**
Don't Know ❑-1 **(SKIP TO Q16)**

15a. In what fiscal year was the Capital Fund Financing Program plan developed?

Year plan developed: ____________
Don't Know ❑-1

15b. Who developed your Capital Fund Financing Program plan? Was it internal staff, an outside organization, or a collaborative effort?

Developed by internal staff ❑1
Developed by an outside organization ❑2
Developed by both internal staff and outside organization ❑3
Don't Know ❑-1

15c. What are the funds being used for? [Please note, if you prefer to type your response, please enter the information into the electronic supplement form]

____

____

16. *IF YOU ANSWERED "NO" OR "DON'T KNOW" IN Q15, ANSWER Q16, OTHERWISE SKIP TO Q18*: Are you aware of the Capital Fund Financing Program or CFFP?

Yes ❑1
No ❑2 **(SKIP TO Q17)**
Don't Know ❑-1 **(SKIP TO Q17)**

16a. Would you consider participating in the Capital Fund Financing Program?

Yes ❑1 **(SKIP TO Q18)**
No ❑2
Don't Know ❑-1

16b. Why would you not consider participating in the Capital Fund Financing Program? [Please note, if you prefer to type your response, please enter the information into the electronic supplement form]

____

____

____

(SKIP TO Q.18)

17. *IF YOU ANSWERED "NO" OR "DON'T KNOW" IN Q16, ANSWER Q17, OTHERWISE SKIP TO Q18]* Under the Capital Fund Financing Program (CFFP), a PHA may borrow private capital to make improvements and pledge, subject to the availability of appropriations, a portion of its future annual Capital Funds to make debt service payments for either a bond or conventional bank loan transaction. Would you consider participating in the Capital Fund Financing Program?

Yes .... ❑1 **(SKIP TO Q18)**
No .... ❑2
Don't Know .... ❑-1

17a. Why would you not consider participating in the Capital Fund Financing Program? [Please note, if you prefer to type your response, please enter the information into the electronic supplement form]

____

____

18. Have you ever taken out a private mortgage to pay for capital improvements that uses the Capital Fund to pay it back?

Yes .... ❑1
No .... ❑2 **(SKIP TO Q19)**
Don't Know .... ❑-1 **(SKIP TO Q19)**

18a. In what fiscal year was the private mortgage obtained?

YEAR MORTGAGE OBTAINED: .... ___________
Don't Know .... ❑-1

18b. Please describe briefly what the private mortgage funds are being used for. [Please note, if you prefer to type your response, please enter the information into the electronic supplement form]

____

____

19. Please indicate all sources of funding available to support the ***capital needs*** of your Public Housing Program (e.g., Capital Fund program, reserves, Operating Subsidy, program income from dwelling rent) your organization expects to receive over the next 5 years. For each funding source, please indicate the fiscal year you expect to receive funding from each source and the amount of funding you expect to receive.

Funding Source	Please indicate Fiscal Year: Fiscal Year	Fiscal Year Definition (Please check one response)	Amount Over Next 5 Years
Public Housing Capital Fund	FY____ FY____ FY___ FY____ FY____	PHA ❑1 Federal ❑2 Calendar ❑3 Other ❑4	$______________
Public Housing Operating Fund	FY____ FY____ FY___ FY____ FY____	PHA ❑1 Federal ❑2 Calendar ❑3 Other ❑4	$______________
Replacement Housing Factor (RHF)	FY____ FY____ FY___ FY____ FY____	PHA ❑1 Federal ❑2 Calendar ❑3 Other ❑4	$______________
City Funding	FY____ FY____ FY___ FY____ FY____	PHA ❑1 Federal ❑2 Calendar ❑3 Other ❑4	$______________
State Funding	FY____ FY____ FY___ FY____ FY____	PHA ❑1 Federal ❑2 Calendar ❑3 Other ❑4	$______________
Program Reserves	FY____ FY____ FY___ FY____ FY____	PHA ❑1 Federal ❑2 Calendar ❑3 Other ❑4	$______________
Rent	FY____ FY____ FY___ FY____ FY____	PHA ❑1 Federal ❑2 Calendar ❑3 Other ❑4	$______________
Other (Specify:_______________ ______________________ ______________________)	FY____ FY____ FY___ FY____ FY____	PHA ❑1 Federal ❑2 Calendar ❑3 Other ❑4	$______________
Other (Specify:_______________ ______________________ ______________________)	FY____ FY____ FY___ FY____ FY____	PHA ❑1 Federal ❑2 Calendar ❑3 Other ❑4	$______________

20. Please describe the process your organization goes through when determining how to allocate funds for capital improvements for your ACC units. [Please note, if you prefer to type your response, please enter the information into the electronic supplement form]

____

____

____

21. Please report the amount of planned capital improvement expenditures in each area over the next five years. (Please note that the amounts reported here should match your five year funding plan.)

BLI	Funding Source	Please indicate Fiscal Year: Planned Amount FY______	Planned Amount FY______	Planned Amount FY______	Planned Amount FY______	Planned Amount FY______
1492	Moving to Work	$______	$______	$______	$______	$______
1406	Operations	$______	$______	$______	$______	$______
1408	Management improvements	$______	$______	$______	$______	$______
1410	Administration	$______	$______	$______	$______	$______
1411	Audit	$______	$______	$______	$______	$______
1430	Fees and costs	$______	$______	$______	$______	$______
1440	Site acquisition	$______	$______	$______	$______	$______
1450	Site improvement	$______	$______	$______	$______	$______
1460	Dwelling structures	$______	$______	$______	$______	$______
1465	Dwelling equipment—nonexpendable	$______	$______	$______	$______	$______
1470	Nondwelling structures	$______	$______	$______	$______	$______
1475	Nondwelling Equipment	$______	$______	$______	$______	$______
1485	Demolition	$______	$______	$______	$______	$______
1495	Relocation Costs	$______	$______	$______	$______	$______
1499	Development	$______	$______	$______	$______	$______
1501	Collateral Exp./Debt Service	$______	$______	$______	$______	$______
1502	Contingency	$______	$______	$______	$______	$______
	Lead-based paint activities	$______	$______	$______	$______	$______
	Accessibility improvements	$______	$______	$______	$______	$______
	Energy efficiency improvements	$______	$______	$______	$______	$______
9000	Debt Reserves	$______	$______	$______	$______	$______
9001	Bond Debt Obligation	$______	$______	$______	$______	$______
9002	Loan Debt Obligation	$______	$______	$______	$______	$______
	Other (Specify:____________________)	$______	$______	$______	$______	$______
	Other (Specify:____________________)	$______	$______	$______	$______	$______

22. What percent of your agency's most recent capital grant funds were used for operations or management (BLIs 1406, 1408 or 1410)?

Percent used for operations or management: ....__________%

Don't Know..❑-1

23. What percent of your agency's most recent capital grant funds were spent on mandated items such as security or accessibility?

Percent used for security/accessibility:………………………..__________% **(If 0% SKIP TO Q24)**

Don't Know..❑-1

23a. What are the mandated items your agency spent capital funds on? *(CHECK ALL THAT APPLY)*

Security ....❑1

Accessibility...❑2

Other (Specify:____) ....❑3

Don't Know... ❑-1

23b. Who requires you to spend capital grant funds on these items? (*CHECK ALL THAT APPLY)*

Board...❑1

Courts..❑2

Voluntary Compliance ....❑3

Other (Specify:____) ....❑4

Don't Know..❑-1

C. Capital Needs Funding Prior Years

Please provide information about your agency's capital fund expenditure for Fiscal Years 2007 and 2006.

24. Please indicate the amount of modernization funding expended in FY2007 and FY2006 for each of the expense categories listed below. Please report the ***actual amounts*** (not estimated amounts).

BLI	Funding Source	Modernization Expenditures FY2007	Modernization Expenditures 2006
1492	Moving to Work	$________________	$________________
1406	Operations	$________________	$________________
1408	Management improvements	$________________	$________________
1410	Administration	$________________	$________________
1411	Audit	$________________	$________________
1430	Fees and costs	$________________	$________________
1440	Site acquisition	$________________	$________________
1450	Site improvement	$________________	$________________
1460	Dwelling structures	$________________	$________________
1465	Dwelling equipment—nonexpendable	$________________	$________________
1470	Nondwelling structures	$________________	$________________
1475	Nondwelling Equipment	$________________	$________________
1485	Demolition	$________________	$________________
1495	Relocation Costs	$________________	$________________
1499	Development	$________________	$________________
1501	Collateral Exp./Debt Service	$________________	$________________
1502	Contingency	$________________	$________________
	Lead-based paint activities	$________________	$________________
	Accessibility improvements	$________________	$________________
	Energy efficiency improvements	$________________	$________________
9000	Debt Reserves	$________________	$________________
9001	Bond Debt Obligation	$________________	$________________
9002	Loan Debt Obligation	$________________	$________________
	Other (Specify:________________)	$________________	$________________
	Other (Specify:________________)	$________________	$________________

D. PHA Accessibility

In this section the questions focus on accessibility improvements made or planned.

25. How many of your public housing units are accessible under Uniform Federal Accessibility Standards (UFAS)?

Number of Units under UFAS ....#__________

Don't Know ....❑-1

26. How much money on average on a per unit basis have you spent over the past 3 years on modifications to make units accessible under UFAS for zero, one, two, and three bedroom units? If a unit type is not applicable, please check that box. If you do not know the unit cost, please check that box.

		PER UNIT COST	CHECK HERE IF UNIT TYPE NOT APPLICABLE	CHECK HERE IF DON'T KNOW
26a.	Per unit cost for 0BR Units	$________	❑-2	❑-1
26b.	Per unit cost for 1BR Units	$________	❑-2	❑-1
26c.	Per unit cost for 2BR Units	$________	❑-2	❑-1
26d.	Per unit cost for 3+BR Units	$________	❑-2	❑-1

27. *[IF YOU ANSWERED "DON'T KNOW" TO any of Q26a-d, THEN ANSWER Q27, OTHERWISE SKIP TO Q.28]* Over the past 3 years, how much did your agency spend on accessibility modifications to make housing units compliant with UFAS? Please record the amount expended over the past three years on the line. If you do not know, please check Don't Know.

Total expenditures for accessibility modifications past 3 years ....$____________

Don't Know ....❑-1

28. Over the past three years, how many accessible units did you add to your total housing inventory?

Number of Accessible Units ....#___________

Don't Know ....❑-1

28a. What is the breakdown of these units? Please record the number of units for each bedroom size.

Number of 0 BR Units ....#__________

Number of 1 BR Units ....#_________

Number of 2 BR Units ....#__________

Number of 3+ BR Units ....#__________

Don't Know...❑-1

29. Please indicate the average accessibility modification cost for each of the following portions of a unit over the ***past 3 years***.

		AVERAGE COST PER UNIT	CHECK HERE IF MODIFICATION TYPE NOT APPLICABLE	CHECK HERE IF DON'T KNOW
29a.	Kitchen	$________	❑-2	❑-1
29b.	Bathroom	$________	❑-2	❑-1
29c.	Ramps	$________	❑-2	❑-1
29d.	Doorways	$________	❑-2	❑-1
29e.	Other (Specify:______________________)	$________	❑-2	❑-1

30. What are your projected expenditures over the ***next five years*** for UFAS accessibility modifications?

Projected expenditures for accessibility modifications......................$__________

Don't Know...❑-1

30a. What do you project for the number of units that you will make accessible in accordance with UFAS through these modifications over the next five years?

Number of UFAS units projected over next five years ....#__________

Don't Know...❑-1

31. What are some of the challenges other than cost that you confront in building accessible units and/or modifying existing units to make them accessible? (CHECK ALL THAT APPLY)

- Takes longer than expected........ ❑1
- Cost over-runs........ ❑2
- Resident inconvenience........ ❑3
- Lack of alternative housing during construction........ ❑4
- Issues with contractors (Specify:________________________) ❑5
- Construction problems (Specify:________________________) ❑6
- Issues with permitting/inspections (Specify:________________). ❑7
- Other (Specify:______________________________) .... ❑8
- Don't Know........ ❑-1

32. Based on your community need, do you find that demand and/or need for accessible units outpace(s) your ability to build/modify units to make them accessible?

- Yes........ ❑1
- No........ ❑2
- Don't Know........ ❑-1

33. What types of requests for accessible units (e.g., hearing impaired, sight impaired, physical impairment) does the HA receive? Please make sure the percentages add up to 100%.

- Hearing Impaired........ _____%
- Sight impaired........ _____%
- Physical impairment........ _____%
- Other impairment........ _____%
- Total........ 100%

34. Does your staff need training on accessibility requirements and modifications?

- Yes........ ❑1
- No........ ❑2
- Don't Know........ ❑-1

E. Healthy Homes Improvements

This next section collects information on improvements related to Healthy Homes, such as lead removal.

35. What percentage of the HA's ACC units have ever undergone lead removal?

Percent of units that have undergone lead removal ....__________%
Don't Know...❑-1
Not applicable – no lead in any HA buildings .... ❑-2

35a. How many of the HA's ACC units still contain lead and need to be abated?

Number of units that still need to undergo lead removal ....#__________
Don't Know...❑-1

36. What is the average per unit cost spent on lead abatement over the last three years?

Average per unit cost for lead removal ....$__________
Don't Know...❑-1

37. What type of challenges, if any, did your organization face in lead abatement? (CHECK ALL THAT APPLY)

Takes longer than expected...❑1
Cost over-runs...❑2
Resident inconvenience...❑3
Lack of alternative housing during construction ....❑4
Issues with contractors (Specify:___________________________________)....❑5
Construction problems (Specify: ___________________________________) ...❑6
Issues with permitting/inspections (specify below) ....❑7
Other (Specify:____) ....❑8
Don't Know...❑-1

F. Energy Efficiency Improvements

In this section questions are focused on any energy improvements your agency has made or planned.

38. Has the HA conducted an energy audit within the last five years?

- Yes, audit was done by HA staff ❑1
- Yes, audit was done by independent qualified energy professional ❑2
- No ❑3 **(SKIP TO Q40)**
- Don't Know ❑-1

39. What was the total amount of potential savings identified by the energy audit?

- Less than 10 percent ❑1
- 10-19 percent ❑2
- 20 percent or more ❑3
- Don't Know ❑-1

40. Has the HA made any energy efficiency upgrades in any of the ACC properties in the past 5 years? This includes upgrading or replacing windows, appliances, heating systems, weatherization as well as replacing incandescent lighting with fluorescent lighting, and installing low-flow toilets, showerheads and faucets.

- Yes ❑1
- No ❑2 **(SKIP TO Q51)**
- Don't Know ❑-1

40a. Were any of these upgrades made in response to an energy efficiency audit?

- Yes, ❑1
- No ❑2
- Don't Know ❑-1

41. What percent of the HA's ACC units have received each of the following energy efficiency upgrades or replacements, whether part of an energy improvement strategy or not?

ENERGY EFFICIENCY UPGRADES OR REPLACEMENTS		NONE	LESS THAN 25 PERCENT	25-49 PERCENT	50-74 PERCENT	75 PERCENT OR MORE	DON'T KNOW
41a.	Windows	❑1	❑2	❑3	❑4	❑5	❑-1
41b.	Appliances	❑1	❑2	❑3	❑4	❑5	❑-1
41c.	HVAC Systems	❑1	❑2	❑3	❑4	❑5	❑-1
41d.	Water	❑1	❑2	❑3	❑4	❑5	❑-1
41e.	Lighting	❑1	❑2	❑3	❑4	❑5	❑-1
41f.	Weatherization/ Building envelope	❑1	❑2	❑3	❑4	❑5	❑-1
41g.	Other (Specify:____________)	❑1	❑2	❑3	❑4	❑5	❑-1

42. Comparing the percentage of ACC units with upgrades completed against your organization's overall energy efficiency upgrade plans would you say that you are on target, ahead of plan, or behind plan?

On target .... ❑1
Ahead of plan .... ❑2
Behind plan .... ❑3
Don't have a plan .... ❑4
Don't Know .... ❑-1

43. What is the average per unit cost associated with energy efficiency upgrades?

ENERGY EFFICIENCY UPGRADES OR REPLACEMENTS		AVERAGE COST PER UNIT	CHECK HERE IF UPGRADE TYPE NOT APPLICABLE	CHECK HERE IF DON'T KNOW
43a.	Windows	$________________	❑-2	❑-1
43b.	Appliances	$________________	❑-2	❑-1
43c.	HVAC Systems	$________________	❑-2	❑-1
43d.	Water	$________________	❑-2	❑-1
43e.	Lighting	$________________	❑-2	❑-1
43f.	Weatherization/ Building envelope	$________________	❑-2	❑-1
43g.	Other (Specify:____________________)	$________________	❑-2	❑-1
43h.	IF 43a-g are DON'T KNOW: Please record the overall cost per unit associated with energy efficiency upgrades	$________________	❑-2	❑-1

44. What type of challenges, if any, did your agency face while making energy efficiency improvements? (CHECK ALL THAT APPLY)

Takes longer than expected..❑1
Cost over-runs..❑2
Resident inconvenience..❑3
Lack of alternative housing during construction ....❑4
Issues with contractors (specify below) ....❑5
Construction problems (specify below)................................❑6
Issues with permitting/inspections (specify below) ....❑7
Other (Specify:____) ....❑8
Don't Know..❑-1

45. What percentage of these energy efficiency upgrades are being funded through the following financing mechanisms?

		PERCENT FUNDED	DON'T KNOW
45a.	An approved rolling basis	________%	❑-1
45b.	An add-on subsidy under loan amortization	________%	❑-1
45c.	Capital Fund or CFFP	________%	❑-1

46. Have you realized any of the savings that you expected from making these energy efficiency improvements?

- Yes .... ❑ 1
- No .... ❑ 2
- Too soon to tell .... ❑ 3
- Don't Know .... ❑ -1

47. Since you implemented the upgrades, how much do you estimate you've saved in energy costs per year based on each of the following energy efficiency upgrades:

		ESTIMATED SAVINGS PER UNIT, PER YEAR	CHECK HERE IF UPGRADE TYPE NOT AVAILABLE	CHECK HERE IF DON'T KNOW
47a.	Window upgrades	$________	❑ -2	❑ -1
47b.	Appliance upgrades	$________	❑ -2	❑ -1
47c.	HVAC upgrades	$________	❑ -2	❑ -1
47d.	Water upgrades	$________	❑ -2	❑ -1
47e.	Lighting upgrades	$________	❑ -2	❑ -1
47f.	Weatherization/ building envelope upgrades	$________	❑ -2	❑ -1
47g.	Other upgrades (Specify:__________________________)	$________	❑ -2	❑ -1

48. Since you implemented the upgrades, what would you estimate as an annual consumption savings for your PHA by installing energy conservation measures over the last 3 years (or most recent year, if 3 years of data is unavailable)?

		LESS THAN 10 PERCENT	10-19 PERCENT	20 PERCENT OR MORE	DON'T KNOW
48a.	Natural gas (therms)	❑ 2	❑ 3	❑ 5	❑ -1
48b.	Electricity (Kwh)	❑ 2	❑ 3	❑ 5	❑ -1
48c.	Oil (gallons)	❑ 2	❑ 3	❑ 5	❑ -1
48d.	Water (gallons)	❑ 2	❑ 3	❑ 5	❑ -1

49. How many self-managed energy performance contracts have you completed or are currently utilizing?

Number of self-managed contracts.. _______ **(IF =”0” SKIP TO 50)**

49a. Are they HA-wide contracts, property specific, or a mix of the two?

HA-wide contracts...❑ 1
Property specific..❑ 2
A mix of the two...❑ 3
Don’t Know..❑ -1

50. How many ESCO-managed energy performance contracts have you completed or are currently utilizing?

Number of ESCO-managed contracts .... _______ **(IF =”0” SKIP TO 51)**

50a. Are they HA-wide contracts, property specific, or a mix of the two?

HA-wide contracts...❑ 1
Property specific..❑ 2
A mix of the two...❑ 3
Don’t Know..❑ -1

G. Transition to Asset Management

This next set of questions are about your PHA's experience with the transition to Asset Management.

51. Has your organization transitioned to Asset Management yet?

Yes ....❑ 1
No..❑ 2
Don't Know ....❑ -1

52. When did your organization complete this transition?

Date.. _____/_______
MM YYYY

Not Applicable ....❑ 2
Don't Know ....❑ -1

53. What impact, if any, do you think that this transition had on your agency's ability to plan and allocate capital funds? [Please note, if you prefer to type your response, please enter the information into the electronic supplement form]

____

____

____

54. Have you had any capital expenditures related to the transition to Asset Management?

Yes ....❑ 1
No..❑ 2
Don't Know ....❑ -1

54a. Describe the type of increased capital expenditures your agency has had as a result of the transition to asset management. [Please note, if you prefer to type your response, please enter the information into the electronic supplement form]

____

____

____

55. Have you had any additional operational or management expenditures related to the transition to Asset Management?

Yes ❑1
No ❑2
Don't Know ❑-1

55a. Describe the type of increased operational or management expenditures your agency has had as a result of the transition to Asset Management. [Please note, if you prefer to type your response, please enter the information into the electronic supplement form]

____
____
____

56. Has your agency received any additional program income as a result of asset management (e.g., renting out unneeded buildings, dispositions, etc.)?

Yes ❑1
No ❑2
Don't Know ❑-1

DOCUMENTS INCLUDED WITH SUBMISSION (PLEASE CHECK):

Capital Fund Financing Program plan, if applicable

- ☐ Enclosed with submission
- ☐ PHA will be sending separately
- ☐ Not applicable

Copies of the latest physical needs assessments for the sampled properties

- ☐ Enclosed with submission
- ☐ PHA will be sending separately
- ☐ Not applicable

Copies of the annual budget (or, at a minimum, an overview of revenue and expenditures) for the entire Housing Agency (as provided in the current-year and five-year Capital Fund program plans)

- ☐ Enclosed with submission
- ☐ PHA will be sending separately
- ☐ Not applicable

A listing of the PIC development numbers for any mixed-finance properties, if applicable

- ☐ Enclosed with submission
- ☐ PHA will be sending separately
- ☐ Not applicable

Copies of any recent energy audits, if applicable

- ☐ Enclosed with submission
- ☐ PHA will be sending separately
- ☐ Not applicable

H. Background Data Form for Sample Properties

The next series of questions are about the specific property identified in Question H1.

1. Sampled Development: «Old_Development_Name»
Name

1a. Sampled Development Number: «Old_Development_Code»

1b. AMP Number: «AMP_code»

1c. Number or Units: «Number_of_Units»

2. Please provide the name and title of person to contact with questions about this form:

____

3. Please provide his/her phone #: (_____)______________________

4. Please provide his/her email Address:

__________________________________@___________________________.____________

5. Is this property subject to any of the following special arrangements:

		YES	NO	DON'T KNOW
5a.	Resident management	❑1	❑2	❑-1
5b.	Private management	❑1	❑2	❑-1
5c.	CFFP funding	❑1	❑2	❑-1
5d.	Energy savings performance contracts	❑1	❑2	❑-1
5e.	Mixed finance	❑1	❑2	❑-1
5f.	Approved demolition	❑1	❑2	❑-1
5g.	Proposed demolition	❑1	❑2	❑-1
5h.	Other special arrangements (Specify:________________________________)	❑1	❑2	❑-1

6. What was the number of turnovers by bedroom size in this property during the last 12 months? If none, enter "zero."

	# TURNOVERS IN PAST 12 MONTHS
0 Bedrooms	___________
1 Bedroom	___________
2 Bedrooms	___________
3 Bedrooms	___________
4+ Bedrooms	___________

7. Thinking only about the property's current ACC **family** units, and how marketable they are to the low-income, public housing market in their current configuration. What proportion of the property's current ACC ***family*** units are:

Marketable to low-income public housing market in current configuration ______% **(IF 100% SKIP to 7b)**

Unmarketable because…

Repair costs are too high to pay at this time and unit is uninhabitable ______%

Current unit configuration does not work (no demand for this size, building type, or layout) ______%

Unmarketable for some other reason (Specify: ___________________________________) ______%

TOTAL 100%

Don't Know..❑-1

7a. Thinking about those ***family*** units that are ***not marketable*** in their current condition to the low-income, public housing market, what proportion would you consider investing capital funds in (if funds are available) to make them marketable?

Proportion of unmarketable family units worth investing in ....______%

Don't Know..❑-1

7b. Think about the proportion of ***family*** units that are ***not marketable*** in their current condition to the low-income, public housing market. Using capital funds (if funds are available), what proportion:

Should be repaired in their current building	______%
Should be upgraded in their current building	______%
Should be reconfigured in their current building	______%
Should be upgraded or reconfigured by tearing down the current building(s) and rebuilding on the current site	______%
Should be upgraded or reconfigured by tearing down the current building(s) and replacing the building(s) on a different site	______%
Should be torn down and not replaced	______%
TOTAL	100%

8. Thinking only about the property's current ACC elderly/disabled units, and how marketable they are to the low-income, public housing market in their current configuration. What proportion of the property's current ACC ***elderly/disabled*** units are:

Marketable to low-income public housing market in current configuration	______%
Unmarketable because …	**(IF 100% SKIP to 7b)**
Repair costs are too high to pay at this time and unit is uninhabitable	______%
Current unit configuration does not work (no demand for this size, building type, or layout)	______%
Unmarketable for some other reason (Specify: ____________________________________)	______%
TOTAL	100%

Don't Know.. -1

8a. Thinking about those ***elderly/disabled*** units that are ***not marketable*** in their current condition to the low-income, public housing market, what proportion would you consider investing capital funds in (if funds are available) to make them marketable?

Proportion of unmarketable elderly/disabled units worth investing in.......______%

Don't Know...❑-1

8b. Think about the proportion of ***elderly/disabled*** units that are ***not marketable*** in their current condition to the low-income, public housing market. Using capital funds (if funds are available), what proportion:

Should be repaired in their current building	______%
Should be upgraded in their current building	______%
Should be reconfigured in their current building	______%
Should be upgraded or reconfigured by tearing down the current building(s) and rebuilding on the current site	______%
Should be upgraded or reconfigured by tearing down the current building(s) and replacing the building(s) on a different site	______%
Should be torn down and not replaced	______%
TOTAL	100%

9. Please provide the planned number of units at this property to be modernized in the next 5 years as well as their average estimated cost:

	NUMBER OF UNITS	AVERAGE ESTIMATED MODERNIZATION COST PER UNIT
Number of units to be substantially rehabbed, next 5 years	__________	$____________
Number of new units to be added, next 5 years	+__________	$____________
Number of units maintained as is, next 5 years	+__________	$____________
Number of units to be demolished, next 5 years	–__________	$____________
Net total units after 5 years	=__________	

10. Please record the lead based paint abatement expenditures for this property first for the most recent year and then for the last 3 years (if none, enter "zero"):

Most recent year:	$________________	❑1 Actual ❑2 Estimate	Funding Source:______________________
Total, last 3 years:	$________________	❑1 Actual ❑2 Estimate	Funding Source:______________________

10a. How many units have undergone lead abatement in the last year, and in the last three years?

Number of units that have undergone lead abatement in last year .... ___________

Number of units that have undergone lead abatement in the last three years .. ___________

11. Please record the amount of accessibility improvement expenditures for this property first for the most recent year and then for the last 3 years (if none, enter “zero”):

Most recent year:	$________________	❑1 Actual ❑2 Estimate	Funding Source:______________________
Total, last 3 years:	$________________	❑1 Actual ❑2 Estimate	Funding Source:______________________

11a. How many units have undergone accessibility modifications in the last year, and in the last three years?

Number of units with accessibility modifications in last year .... ____________

Number of units with accessibility modifications in the last three years .... ____________

12. Please record the amount of energy efficiency upgrade expenditures for this property first for the most recent year and then for the last 3 years (if none, enter “zero”):

Most recent year:	$________________	❑1 Actual ❑2 Estimate	Funding Source:______________________
Total, last 3 years:	$________________	❑1 Actual ❑2 Estimate	Funding Source:______________________

12a. How many units have undergone energy efficiency modifications in the last year, and in the last three years?

Number of units with efficiency upgrades in last year .... ____________

Number of units with efficiency upgrades in the last three years .... ____________

13. What is the total amount of capital fund grant money *received in FY 2007* for this property (including obligated as well as expended)?

$________________________

Don’t Know .... ❑-1

14. What is the total amount of capital fund grant money *expended* in the prior three years (2005-2007) for this property :

$________________________

Don’t Know .... ❑-1

15. What is the total estimated spending *planned for the next five years,* for this property:

$________________________

Don't Know .... ❑-1

16. Please list here the estimate of per-unit hard costs for physical needs:

$________________________

Don't Know .... ❑-1

17. Please indicate whether each of the following utility bills are paid by the resident or by the PHA for this development? (Please check the appropriate responses)

UTILITY BILL	RESIDENT PAID	PHA PAID	DON'T KNOW
Electricity bill	❑1	❑2	❑-1
Electricity bills specifically for air conditioning	❑1	❑2	❑-1
Gas/oil bills	❑1	❑2	❑-1
Water bills	❑1	❑2	❑-1
Other (Specify:______________________________)	❑1	❑2	❑-1

18. Does this property have central air conditioning?

Yes .... ❑1

No .... ❑2

Don't Know .... ❑-1

Capital Needs Funding Prior Years

19. Please indicate modernization funding expended over the past 10 years (between 1998 and 2007) for the expense categories listed below. Please report the ***actual*** amounts (not estimated amounts). If you have a printout with this information, you can submit it with this form.

BLI	FUNDING	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
	Capital Fund Financing Program (CFFP)	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____
	Replacement Housing Factor (RHF)	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____
1492	Moving to Work	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____
1406	Operations	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____
1408	Management improvements	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____
1410	Administration	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____
1411	Audit	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____
1430	Fees and costs	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____
1440	Site acquisition	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____
1450	Site improvement	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____
1460	Dwelling structures	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____
1465	Dwelling equipment—nonexpendable	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____
1470	Nondwelling structures	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____
1475	Nondwelling Equipment	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____
1485	Demolition	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____
1495	Relocation Costs	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____
1499	Development	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____
1501	Collateral Exp./Debt Service	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____
1502	Contingency	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____
	Lead-based paint activities	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____
	Accessibility improvements	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____
	Energy efficiency improvements	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____
9000	Debt Reserves	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____
9001	Bond Debt Obligation	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____
9002	Loan Debt Obligation	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____
	Other (Specify:____________________)	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____

Details on Offline Buildings

20. For each offline building in the development, please give the address of the building, the building type, the reason for the building being offline and the expected duration. The abbreviations for "building type" are:
HR = High Rise (with elevator) WU = Walk-up (multifamily) TH = Row/Townhouse SF = Single Family CB = Common Building

Building Address	Building Type	Reason Building is Offline	Duration	
	HR=Highrise WU=Walkup TH =Townhouse SF=Single Family CB=Community Building (Circle One)	*Using codes listed below, circle the code or the reason below for each building offline* *1 – Ready for Demolition/No Rebuilding* *2 – Recent Natural Disaster* *3 – In Process of Being Modernized/Upgraded* *4 – In Process of Being Reconfigured* *5 – Other (Please Specify)*	*Enter date expected to go online using MM/DD/YYYY*	*If never planning to go online, check here*
	HR☐ WU☐ TH☐ SF☐ CB☐	1☐ 2☐ 3☐ 4☐ 5☐ (specify:) ____	____/____/____	☐
	HR☐ WU☐ TH☐ SF☐ CB☐	1☐ 2☐ 3☐ 4☐ 5☐ (specify:) ____	____/____/____	☐
	HR☐ WU☐ TH☐ SF☐ CB☐	1☐ 2☐ 3☐ 4☐ 5☐ (specify:) ____	____/____/____	☐
	HR☐ WU☐ TH☐ SF☐ CB☐	1☐ 2☐ 3☐ 4☐ 5☐ (specify:) ____	____/____/____	☐
	HR☐ WU☐ TH☐ SF☐ CB☐	1☐ 2☐ 3☐ 4☐ 5☐ (specify:) ____	____/____/____	☐
	HR☐ WU☐ TH☐ SF☐ CB☐	1☐ 2☐ 3☐ 4☐ 5☐ (specify:) ____	____/____/____	☐
	HR☐ WU☐ TH☐ SF☐ CB☐	1☐ 2☐ 3☐ 4☐ 5☐ (specify:) ____	____/____/____	☐
	HR☐ WU☐ TH☐ SF☐ CB☐	1☐ 2☐ 3☐ 4☐ 5☐ (specify:) ____	____/____/____	☐
	HR☐ WU☐ TH☐ SF☐ CB☐	1☐ 2☐ 3☐ 4☐ 5☐ (specify:) ____	____/____/____	☐

Details on Vacant Units

21. For each unit type where there are vacancies, please indicate the number of vacant units for each bedroom type. If the reason is “Other,” please describe below.

	O BR	1 BR	2 BR	3+ BR
	# of Units	# of Units	# of Units	# of Units
Turnover	________	________	________	________
Being modernized	________	________	________	________
Being converted for accessibility	________	________	________	________
In an offline building	________	________	________	________
Used for other purposes	________	________	________	________
Unmarketable	________	________	________	________
Other (Please Specify Below)	________	________	________	________

Appendix C. System for Estimating Inspection-Based Existing Modernization Needs and Accrual Costs from Inspections

This appendix outlines the approach used to estimate existing modernization needs and accrual costs based on the observations made during physical inspections of the properties. ***Existing modernization needs*** are the immediate repair costs that would have to be expended in order to provide decent and sustainable housing with modest amenities. The costs include *minor, moderate, or major repairs* or the immediate *replacement* of system items, according to the professional judgment of the inspector. ***Accrual costs*** are costs expected as items age over the next twenty years and are typically associated with major repairs and replacement of system items.

The first section of this appendix presents the method for arriving at costs of existing modernization needs. The second section describes the method for estimating the future accrual costs.

C.1. Estimating Inspection-based Existing Modernization Needs from Property Inspections

The process of estimating the existing modernization needs based on the property inspections involved six steps:

- Conduct an item-level physical inspection of the overall site, up to 4 buildings, and 4 units within each property in the sample (548 properties were inspected as part of the sample, including 1,849 buildings and 2,192 units);
- Generate an item-level cost file for each system;
- Calculate item-level costs for the site, inspected units, and inspected buildings;
- Compute property-level costs by inferring costs for uninspected units and buildings from inspected units and buildings; and
- Adjust the property-level costs for locational cost differences and for soft costs associated with mark-ups, such as overhead and PHA management expenses.

Physical Inspection of the Property

The physical inspection method—the Observable Systems Method—was described previously in Appendix B. The inspection produces a complete inventory of the 321 items that in each property that includes information on whether the item is present, count or dimension (size), material type, immediate repair action level, percent of repair required, current age, remaining life (RL), and expected useful life (EUL).

System-Level Cost File for Computing Physical Needs

As was discussed in Appendix B, under the Observable Systems Method, the costs of carrying out the repair actions recorded by the inspector were computed off-site using a computerized cost file and program. The first step in generating the cost file was developing up to five system-specific, categorized levels of repair actions—ranging from no action to replacement of a system—to correspond to action levels the inspector would use to describe the repairs needed to bring the system up to a working, safe, and sound condition.

The five systems are:

- Site Systems (SS);
- Building Architecture (BA);
- Mechanical Room (MR);
- Building Mechanical and Electrical (BME); and
- Dwelling Unit (DU).

The five repair action levels are:

- *NA* for no action;
- *MIN* for minor repair;
- *MOD* for moderate repair;
- *MAJ* for major repair; and
- *REPL* for replacement.

For any system, each action level denotes a specific repair action. For example, for basketball courts (a Site System item), the MIN action is to replace a missing backboard; the MOD action is to replace the backboard and support of one basketball hoop; the MAJ action is to replace the backboard and support of two basketball hoops; and REP involves rebuilding the entire court, including relining and installing new baskets, backboards, and support posts. In the above example for basketball courts, the MIN cost is $1,500 for each site requiring MIN action. MOD costs are $2,550 for each site requiring a MOD level of repair. MAJ costs are $5,100 for each site. REPL costs are $33,847.[11]

Not all systems have five distinct action levels. For example, for garbage disposals, the only allowable action is REPL, which replaces the garbage disposal at a cost of $264. The Inspection Field Guide for this study details each allowable action level for each system.

System repair costs were obtained from A.M. Fogarty & Associates, Inc., a firm with extensive experience in costing for private and public housing construction and modernization. Using the precise definitions of the action levels described above, A.M. Fogarty & Associates, Inc. developed a series of costs for each action level for each system that reflects the materials commonly used for

[11] These repair costs do not include any mark-ups, such as soft costs or overhead, profits, and contingency. Adjustments for project locations and for other mark-ups, as part of the costing algorithm, are discussed below

public or low-income housing. Abt Associates Inc. has used this firm's estimation services for several HUD studies, including the prior Capital Needs study that was conducted in 1998. The complete Fogarty costs file includes repair cost estimates for a total of 700+ system item types—for different combinations of material types and size categories. Exhibit C-1 lists a sample of the elements from the Fogarty costs file (first 28 elements of the BA section).

The costs represent national averages and include parts, labor, and contractor fees for the modernization project. Costs do not include any mark-ups, such as soft costs or overhead, profits, and contingency. Adjustments for project locations and for other mark-ups, as part of the costing algorithm, are discussed below.

System-Level Costs for the Site, Inspected Units, and Buildings

In this step, the inspector's observations and the cost files were combined to calculate, for each property, costs for immediate repair actions on inspected items. A mathematical costing algorithm, written in a SAS program, was applied to each item the inspector checked off as present in the sampled buildings and units. The basic concept is multiplying the per-unit cost by a quantity measure, where the quantity measure may be scaled by a percentage of the item affected.

In preparation for calculating the costs, the algorithm first links all data elements for each inspected system item together using a uniformly-reported HUD Project ID, Building ID, and Unit ID. Based on the item's material type, size category and repair action reported by the inspector, the item is linked to the appropriate per-unit cost form the Fogarty cost file. The inspected item costs are then calculated as follows:

Inspected item cost = (Observed item quantity) * (Percent of item in need of repair action) * (Per-unit Fogarty cost for the repair action)

For example, let us suppose that an inspected unit had a total of six vinyl-clad sliding windows (the observed quantity). The inspector determined that three of these windows were in need of a moderate (MOD) repair action; the remaining three would require no action (NA). Based on the type and size of the window, the costing algorithm identifies the appropriate per-unit repair cost: $50 for a MOD repair action. The inspected item cost can be obtained by multiplying the total quantity of observed items (6 windows) by the percentage of items in need of an immediate action (50 percent) by the per-unit cost of the necessary action ($50 for a MOD action): 6*0.50*$50 = $150.

Exhibit C-1. Sample Elements of the Fogarty Cost File

System	Item Code	Category	Item	Unit of Measure	MIN	MOD	MAJ	REPL
BA	549	EXTERIOR STAIRS	TYPE 1 - RESIDENTIAL WOOD - SIZE 2 - FULL	EA	.	$350	$1,650	$3,300
BA	550	BASEMENT STAIRS	TYPE 1 - WOOD - SIZE 1 - HALF	EA	.	$350	$725	$1,450
BA	551	BASEMENT STAIRS	TYPE 1 - WOOD - SIZE 2 - FULL	EA	.	$750	$1,350	$2,700
BA	552	BASEMENT STAIRS	TYPE 2 - CONCRETE - SIZE 1 - HALF	EA	.	$750	$1,238	$2,475
BA	553	BASEMENT STAIRS	TYPE 2 - CONCRETE - SIZE 2 - FULL	EA	.	$1,200	$1,913	$3,825
BA	554	BASEMENT STAIRS	TYPE 3 - CONCRETE FILLED STEEL - SIZE 1 - HALF	EA	.	$1,200	$2,872	$5,744
BA	555	BASEMENT STAIRS	TYPE 3 - CONCRETE FILLED STEEL - SIZE 2 - FULL	EA	.	$1,200	$5,194	$10,388
BA	556	SLAB	TYPE 1 - 4" SLAB ON GRADE	SF	.	.	.	$6
BA	557	SLAB	TYPE 2 - 8" STRUCTURAL SLAB	SF	.	.	.	$11
BA	558	EXTERIOR STAIRS	TYPE 1 - RESIDENTIAL WOOD - SIZE 1 - HALF	EA	.	$350	$850	$1,700
BA	559	EXTERIOR STAIRS	TYPE 2 - CONCRETE - SIZE 1 - HALF	EA	.	$750	$1,238	$2,475
BA	560	EXTERIOR STAIRS	TYPE 2 - CONCRETE - SIZE 2 - FULL	EA	.	$1,200	$1,913	$3,825
BA	561	EXTERIOR STAIRS	TYPE 3 - STEEL, CEMENT FILL PAN - SIZE 1 - HALF	EA	.	$1,000	$2,525	$5,050
BA	562	EXTERIOR STAIRS	TYPE 3 - STEEL, CEMENT FILL PAN - SIZE 2 - FULL	EA	.	$1,500	$4,675	$9,350
BA	563	FLOOR FRAME	WOOD FLOOR FRAME	SF	.	$8	.	$100
BA	564	CANOPIES	TYPE 1 - WOOD - SIZE 1 - SMALL <36 SF	EA	.	$1,260	.	$2,700
BA	565	CANOPIES	TYPE 1 - WOOD - SIZE 2 - MEDIUM 37-200 SF	EA	.	$2,400	.	$7,500
BA	566	CANOPIES	TYPE 1 - WOOD - SIZE 3 - LARGE 201 SF	EA	.	$3,400	.	$12,500
BA	567	CANOPIES	TYPE 2 - CONCRETE - SIZE 1 - SMALL <36 SF	EA	.	$1,620	.	$4,500
BA	568	CANOPIES	TYPE 2 - CONCRETE - SIZE 2 - MEDIUM 37-200 SF	EA	.	$4,700	.	$11,250
BA	569	CANOPIES	TYPE 2 - CONCRETE - SIZE 3 - LARGE 201 SF	EA	.	$7,700	.	$18,750
BA	570	EXTERIOR COMMON DOORS	TYPE 1 - ALUM/GLASS - SIZE 1 - SINGLE TYPE 1 ONLY	EA	.	$1,305	$1,540	$1,890
BA	571	EXTERIOR COMMON DOORS	TYPE 1 - ALUM/GLASS - SIZE 2 - DOUBLE TYPE 1 ONLY	EA	.	$2,110	$3,080	$3,530
BA	572	EXTERIOR COMMON DOORS	TYPE 2 - WOOD/METAL - SIZE 1 - SINGLE TYPE 1 ONLY	EA	.	$1,305	$1,410	$1,710
BA	573	EXTERIOR COMMON DOORS	TYPE 2 - WOOD/METAL - SIZE 2 - DOUBLE TYPE 1 ONLY	EA	.	$2,110	$2,315	$2,665
BA	574	EXTERIOR COMMON DOORS	TYPE 3 - AUTOMATIC SLIDING - SIZE 1 - SINGLE TYPE 1 ONLY	EA	.	$1,300	$9,025	$9,025
BA	575	EXTERIOR UNIT DOORS	WOOD EXTERIOR DOOR	EA	.	$500	$855	$1,079
BA	576	EXTERIOR UNIT DOORS	METAL EXTERIOR DOOR	EA	.	$500	$730	$954

Notes: Costs based on national averages. No markups are applied. The complete cost file contains 700+ rows of data.

For system items (for example, roadways) where the Fogarty cost was measured on a per square foot or linear foot basis, the algorithm made use of the item's dimension measures reported on the Takeoffs pages of the inspection form. Other costing algorithms were based on the number of inspected items requiring action, as in the case of windows described above.

After the item costs were calculated, they were grouped together to form system level estimates. For instance, costs for all the items on the BA inspection form were added up to form the cost estimate for the BA system.

Property-Level Costs

In order to generate costs for the property as a whole, costs for buildings and units that were not inspected needed to be estimated. This is not true for the Site Systems as all the site elements were inspected.

For each property, costs were generated for the residential buildings and units that were not inspected based on their relationship to buildings and units that were inspected. In essence, costs from inspected buildings of a certain type were used to estimate costs for uninspected buildings of that type in the project. Similarly, costs from inspected units of a certain type were used to estimate costs for uninspected units of that type. During the inspection process, the inspector, in conjunction with the PHA staff, filled out an additional form that included the breakdown of buildings by type (high-rise/elevator structure (HR), walk-up/garden (WU), row-house/townhouse (RW), single-family detached or semi-detached (SF)) and units by type (0-bedroom, 1-bedroom, 2-bedroom, 3+bedroom), and occupancy status for the entire project. All buildings and units in the project were included on this form, regardless of whether they were included in the inspection. Depending on the size and complexity of the project, the inspector either reported this information by each building in the Inspection Building and Unit Type form (IBUT) or in a summary format in the Consolidated Inspection Building and Unit Type form (CIBUT).

Based on data reported in the IBUT and CIBUT forms, the costing algorithm calculated a project-wide count of buildings by type (WU, HR, SF, RW) and a sum of units by bedroom size (0 BR, 1 BR, 2 BR, 3+ BR). These totals provided the counts to which all the inspected item costs had to be extrapolated to generate the property-wide estimates.

To perform the adjustment to account for uninspected buildings and units, each building type and unit type within a project was assigned an extrapolation factor—a number by which all inspected item costs should be multiplied to arrive at the property-wide estimate. For example, if costs from an inspected one-bedroom unit were used to estimate costs for three other one-bedroom units in the property, then the extrapolation factor would be 4 (it means that the costs apply to four one-bedroom units). For each building and unit type, the algorithm calculated the extrapolation factor with the following formula:

$$\frac{\text{Total count of buildings or units of the indicated type in the } \textit{ENTIRE} \text{ property}}{\text{Total count of } \textit{INSPECTED} \text{ buildings or units of the indicated type in the project}}$$

For example, assume a small property with 100 one-bedroom units across two high rise buildings. In this example, assume two units and one building were inspected. Say, the algorithm yields total existing repair costs of $2,000 and $3,000 for the two inspected units, and $25,000 for the inspected building (total existing repair costs are a sum of all items in an inspected site, unit, building, and will be discussed in more detail below).

The algorithm calculates extrapolation factors separately for the inspected units and inspected buildings regardless of whether the inspected units are located within the inspected buildings because the buildings and units were sampled independently. In this example, for the one-bedroom units, the extrapolation factor is equal to the total number of one-bedroom units in the property (100) divided by the total count of inspected one-bedroom units (2). For the high rise buildings, the extrapolation factor is equal to the total number of high rise buildings in the property (2) divided by the total count of inspected high rise buildings (1). To generate property-wide cost estimates, the costs associated with each inspected one-bedroom unit would be multiplied by a factor of 50 (50*$2,000 + 50*3,000 = $250,000), and the costs associated with the inspected high rise building would be multiplied by a factor of 2 (2*$25,000 = $50,000).

Estimating Project-Level Costs for Building Mechanical and Electrical and Mechanical Room Data

In most cases, the items inspected using the Building Mechanical and Electrical (BME) and Mechanical Room (MR) forms applied exclusively to an inspected building, covering all units in that building and no others. Under such circumstances, property-level cost estimates were calculated using the same method described above for the Building Architecture costs.

For some rare cases, however, an inspected mechanical room and/or electrical system within an inspected building provided power to two or more buildings in the property, not all of which were sampled for inspection. To ensure that the property-wide costs did not overestimate the repair needs of these systems, the algorithm only extrapolated BME and MR estimates to cover the portion of costs that are associated with the inspected building. To do so, the algorithm calculated the percent of units in buildings for which a Building Architecture inspection was completed that were covered by each inspected MR or BME system. The formula for this adjustment factor was as follows:

$$\frac{\text{Total units in the inspected building (reported in the BA form)}}{\text{Total units associated with the BME/MR system (reported in the BME/MR form)}}$$

For example, let us suppose that the inspector reported that the inspected 100-unit high-rise building from the previous example had a large mechanical room that also provided power to a second neighboring 100-unit high-rise (which was not part of the inspection sample). The MR inspection yielded a total existing needs of $5,000. To ensure that the property-wide estimates did not overestimate costs associated with the MR inspection, the algorithm reduced this cost to account for only the MR services going to the inspected building. The building-level estimate for existing MR repair costs were therefore adjusted as follows: 100/200*$5,000=$2,500. This cost was then extrapolated to a property-wide estimate using the extrapolation coefficient for that particular building type.

Some properties had stand-alone MR or BME systems that served the entire property. The inspected costs for these items were treated like the costs for site system items.

Adjustments to the Property-Level Cost Numbers for Locations and Mark-ups

The item repair and replacement costs created by A.M. Fogarty & Associates, Inc. were based on the national average of current costs. Using the R.S. Means "Location Factors" (R.S. Means index) published in the 2008 version of the Means Square Foot Costs Book, the property-level costs were adjusted by multiplying them by the ratio of the R.S. Means Index for the city where the property is located to the R.S. Means index relative to the national average. For example, the computed cost for a New York City property would be adjusted by a factor of 131.3, since costs in New York City are 31.3 percent higher than the national average. The algorithm mapped all local adjustment factors from the R.S. Means index to the inspection data based on the first three digits of the inspected project's zip code, as reported on the Site Systems form.

The cost elements include all parts, labor, and contractor fees for modernization. Costs do not include mark-ups for general conditions, overhead, contingency, profit, soft-costs, or PHA management expenses. To account for these costs, all capital needs estimates were inflated by a factor of 53.9 percent—10 percent for general conditions, 15 percent for overhead, 4 percent for contingency, and 17 percent for soft costs and PHA management, combined.

Treatment of Over-Age System Items

Based on the system item's conditions, the inspector used his or her professional judgment to determine whether an item was still functioning and thus did not require an immediate repair action—regardless of whether its current age was beyond the expected useful life for the item. The costing algorithm assumes that the next repair action would happen at the end of the expected remaining life determined by the inspector. The only exception is when the remaining life field indicates that there is 1 year. For such cases, the algorithm assumes the repair action would happen immediately and resets the remaining life value to 0 year, effectively forcing an immediate replacement (or repair, if that is the correct accrual action).

The algorithm also checks for cases where the inspector indicated that no immediate action was required, but the item's remaining life was zero. In such cases, since the item had no remaining life, the algorithm forced an immediate replacement action.

Upgrade Repair Actions

For particular groupings of site and unit items (for example, bathroom fixtures), if a large portion of the items require significant repair actions, it is a common practice in the industry to simply replace all items in the group rather than performing major repairs on several items while leaving the others untouched. This practice is referred to as *upgrade* repairs in this study. System items eligible for upgrade are grouped into the following categories:

- *SITE SURFACE (SS)*
  - Roadways
  - Parking
  - Sidewalks
  - Fencing
  - Dumpster Enclosures

- *SITE DEVELOPMENT (SS)*
  - Site Lighting
  - Site Amenities
  - Signage
  - Play Equipment

- *KITCHEN (DU)*
  - Cabinet
  - Countertop/Sink/Faucet
  - Dishwasher
  - Range
  - Rangehood
  - Refrigerator

- *BATHROOM (DU):*
  - Tubs
  - Toilets
  - Sinks
  - Vanity
  - Accessories/Grab Bars

For each of the upgrade groups, if three or more items were determined by the inspector to require an immediate replacement, the costing algorithm would automatically carry out an immediate replacement for all items in that group. For example, suppose in housing unit A-1 the inspector marked in the inspection forms that the kitchen cabinet, range, and rangehood required immediate replacement, while the other kitchen items were reported as in working condition and would require no repair action. The algorithm would trigger the kitchen upgrade flag and automatically replace all the six items (cabinet, countertop/sink/faucet, dishwasher, range, rangehood, and refrigerator) in that housing unit, regardless the original repair actions determined by the inspector. However, items in the group reported as Not Present would not be added to the unit.

Each of the four upgrade groups are accessed independently, so any upgrade for a unit's bathroom would not trigger the repairs in the kitchen or even in another bathroom of the same unit.

Exhibit C-2 presents the prevalence of upgrade repairs in the inspection universe, separately by the type of upgrade and by the various subgroups of properties of interest.

Exhibit C-2.	Proportion of Units in the Inspection Universe With Upgrade Actions (Weighted)					
	Any Upgrade	Site Upgrade	Kitchen Upgrade	Bathroom Upgrade	Kitchen and Bathroom Upgrade	Site, Kitchen, and Bathroom Upgrade
All	0.46	0.09	0.25	0.34	0.16	0.04
All (except NYC, Chicago, Puerto Rico)	0.46	0.09	0.27	0.35	0.18	0.04
HA Size						
Less than 250 Units	0.47	0.07	0.20	0.35	0.15	0.00
250-1,249 Units	0.41	0.08	0.26	0.28	0.15	0.04
1,250-6,600 Units	0.48	0.09	0.30	0.40	0.22	0.05
6,600+ Units	0.58	0.15	0.38	0.43	0.24	0.13
NYC	0.50	0.12	0.26	0.30	0.13	0.03
Chicago	0.00	0.00	0.00	0.00	0.00	0.00
Puerto Rico	0.56	0.03	0.11	0.43	0.00	0.00
Census Region						
Northeast	0.47	0.07	0.26	0.30	0.12	0.02
Midwest	0.27	0.03	0.10	0.18	0.05	0.00
South	0.48	0.06	0.26	0.38	0.18	0.01
West	0.81	0.46	0.59	0.66	0.52	0.33
Building Type						
High-rise/Elevator	0.41	0.09	0.24	0.28	0.14	0.02
Walk-up/Garden	0.55	0.07	0.32	0.31	0.10	0.02
Row-house/Townhouse	0.47	0.09	0.24	0.39	0.20	0.05
Single-family Detached/ Semi-detached	0.52	0.10	0.42	0.42	0.31	0.10
Occupancy Type						
Family	0.47	0.10	0.24	0.35	0.15	0.04
Elderly	0.42	0.06	0.28	0.31	0.18	0.03

Treatment of Outlier System Costs

A small proportion of sample developments had per-unit system cost estimates that were far higher than one would normally be expected. A case in point is a sample property located in a rural township (Morristown) in Tennessee. The site has a total gross area of over 1,000,000 SF (compared with the mean site area of 643,000 SF across the study sample). The property consists of only 146 housing units in total. The average building age is 36 years. According to the inspector, many of the site systems are over-age with no remaining life left and would require immediate replacement. These include a number of systems that are expensive to replace: site water main (179,000 LF), site gas main (210,000 LF), cold water lines (179,000 LF), and gas lines (128,000 LF). Given the large site area covered and the fact that there are only a small number of units to share the costs, the estimated total existing needs exceed $300,000 on a per unit basis.

As another example, a sample property located in Birmingham, AL contains 70+ walk-up/garden and rowhouse/townhouse buildings, with a total of 500+ units. All of the four sample buildings inspected are 40+ years old with severe deferred maintenance. Based on the inspector's professional judgments, many of the building systems are over-age with no remaining life left and would require immediate replacement. In particular, all the windows (42 to 62 windows per building, or about 6.5 windows per unit) and roof covering (4,100 to 6,500 SF per building) of the sample buildings would require replacement. Since windows and roof covering are among the most expensive items to replace across all systems and there are relatively few units on a per building basis to spread the replacement costs, the estimated total existing needs for the entire property exceed $100,000 on a per unit basis.

While cases like these are legitimate, they are atypical and do not represent the general public housing stock. To ensure that the costing algorithm would be able to produce reliable estimates at the national and various subgroup levels, we have reduced the outlier costs by capping the top one percent of the per-unit costs. For these records, the system costs were changed to be the average system cost (calculated by excluding the top one percent cases) plus two times the standard deviation of the system costs (also calculated by excluding the top one percent cases). This was done separately for the five systems (SS, MR, BME, BA, and DU).

Exhibit C-4 at the end of the Appendix identifies, separately for the five systems, the threshold cost values, the caps, and the number of sample development affected by this adjustment.

C.2. Estimating Accrual of Repair and Replacement Costs

Accrual cost estimates are the total amount (in current dollars) a property will need in order to cover expected repairs and replacements for each system over each of the next 20 years. As part of the inspection process, for each system item, the inspector recorded the immediate repair action level required along with age, number of such systems or take-off measurements, estimates of the remaining life and expected useful life. As explained above, the immediate repair level was used to estimate existing needs for the inspected item, which were then extrapolated to property-level existing cost estimates. The remaining life and expected useful life information, in turn, would be used to estimate the twenty-year accrual of repair and replacement costs associated with the standard wear of each inspected item. The algorithm for calculating the accrual estimates assumes that all existing needs are met as part of addressing existing needs and all items in the site, building, or unit are in good working order.

For each of the next 20 years, we tested whether each of the inspected items would reach the end of its useful life that year. The costing algorithm first checked the repair action level determined by the inspector. If an immediate repair action was recommended (MIN, MOD, MAJ, or REPL), then the accrual cycle was reset and the first out-year action (i.e., timing of the 1st repair action *after* the immediate repair recommended by the inspector has been carried out) was set to occur at the end of the item's expected useful life, not at the end of the remaining life reported by the inspector. We assumed that the required repair action would bring the item back to its original working order and it would be able to function throughout an entire expected useful life cycle. For example, a new electrical boiler was assumed to have an expected useful life of 40 years. Assume a particular electrical boiler was inspected and determined to have a remaining life of 2 years. Given its current condition, the inspector also determined that it would require an immediate major (MAJ) repair action level. Consequently, the costing algorithm would assume the first out-year repair would happen at the 40th year after the inspection (not at the end of the reported remaining life); the second out-year repair would occur at the 80th year (40 + 40) after the inspection; and so on.

For items that were determined to require no immediate repair action by the inspector, the algorithm set the first out-year action to occur at the item's reported remaining life (RL). For example, if an electrical boiler required no immediate repairs, had a reported remaining life of 5 years, and an EUL of 40 years, then the existing modernization needs would be zero and the first repair would happen on the 5th out-year (5 years after the inspection); the second repair would occur in the 45th out-year (5 + 40); the third repair would occur in the 85th out-year (5 + 40 + 40); and so on.

After determining the timing of an accrual action, the algorithm mapped each inspected item to the appropriate Fogarty cost and calculated the accrual costs as the total number of items multiplied by the unit-cost (100 percent of all items were affected for accrual actions). These costs were then scaled up using the same set of extrapolation coefficients used for the estimates of existing needs to reflect the property-level cost and then adjusted for local pricing and mark-ups.

Special Considerations when Calculating Accrual Costs

Interior Walls and Ceilings

In public housing, the expenses for repainting interior walls and ceiling often come out of the PHA's operating funds, instead of capital funds. Therefore, for the purpose of this study, repainting or wallpapering of interior wall and ceilings is not considered to be capital expenses unless an immediate repair action is required because of deferred maintenance. Thus, out-year repair actions for such items are not part of the accrual estimates.

Special accrual Items

For the vast majority of system items, out-year repairs imply item replacements. For a number of the items, types, such as chimneys and basketball courts, it would not make sense to replace the item when its useful life ran out. Instead, these items would be assigned by the algorithm either a minor, moderate, or major repair action level, rather than a replacement. Exhibit C-3 identifies such special accrual items, the accrual action levels, and years of the accrual cycle.

For example, when an elevator shaftway reached the end of its remaining life, the algorithm did not automatically trigger a replacement action for that year ($16,000 per unit). Rather, a major repair cost would be applied ($7,500 per unit).

Exhibit C-3. System Items With Special Accrual Repair Action Levels and Life Cycles

Item	Out-Year Repair Action
SS	
Roadways	MAJ
Parking	MAJ
Sidewalks	REPL for type 1; MAJ for types 2 and 3
Retaining Walls	MOD for all types
Landscaping	Immediate action, if needed, no out year actions
Pool	MAJ
Pool Deck	MAJ
Catch Basins	MOD every 40 years
Basketball Courts	MOD every 15 years
Tennis Courts	MIN every 20 years
Tennis Court Fence	REPL every 20 years
MR	
Combustion Air	REPL for types 1 and 3 every 99 years; REPL for type 4 every 25 years; REPL type 2 every 45 years
BME	
Fire Suppression	MIN every 35 years
Fire Pumps	MOD every 20 years
Evaporative Cooler	MAJ every 15 years
Shaftways And Machinery	MAJ every 30 years
BA	
Exterior Common Doors	MAJ for type 3; REPL for types 1 and 2
Canopies	MOD for type 2; REPL for type 1
Exterior Ceilings	MOD
Soffits/Fascia/Cornice	MOD
Fire Escape	MAJ
Exterior Walls	MIN for types 1-5, and 10-13; MOD for types 6-9; REPL for type 14
Roof Drainage - Exterior	MOD
Chimneys	MIN
Penthouse	MAJ
Floors	MAJ for types 3 and 4; REPL for other types
Interior Ceilings And Walls	immediate action, if needed, next action after 99 years (no out year costs)
DU	
Hallway Doors	MAJ
Unit Doors	MAJ
Unit Floors	Replace all except type 5,6 for those action is MAJ
Interior Ceilings And Walls	Immediate action, if needed, no out year actions

Treatment of Outlier System Costs

Outlier estimates are found in a small subset of the sample properties. An example of such outliers is the property located in Morristown, TN, discussed in Section C.1. Because it encompasses a large site area but relatively small number of units, many of its site systems have a high accrual cost as well as immediate repair costs on a per unit basis. The overall accrual needs are estimated to be over $31,000 per unit each year over the next 20 years. This is an outlier case as most of the public housing developments across the country are not constructed in such large site area given the number of units.

Outliers of accrual estimates were adjusted the same way that the outliers of per-unit existing needs were treated. The per-unit average annual accrual costs of the top 1 percentile were capped at the mean value plus twice the standard deviation for the system, where the mean and standard deviation were calculated without the top 1 percentile cases. This was done separately for the five system costs (SS, MR, BME, BA, and DU).[12]

Exhibit C-4 identifies, separately for the five systems, the threshold cost values, the caps, and the number of sample development affected.

Exhibit C-4. Threshold Values and Caps for Outlier System Costs

System	Threshold (Cutoff): 99th Percentile	Number of Sample Properties Affected	Cap: Mean + 2 x Std Dev, Excluding 99th Percentile Values
Existing Modernization Needs (Per Unit)			
SS	$31,594	6	$12,649
BA	$43,731	6	$25,730
BME	$18,152	4	$8,695
MR	$5,915	4	$2,601
DU	$29,058	6	$22,018
Average Annual Accrual Needs (Per Unit)			
SS	$65,231	6	$23,000
BA	$60,787	6	$38,740
BME	$28,157	4	$17,011
MR	$22,059	4	$9,782
DU	$58,744	6	$49,328

12 For estimates reported in Exhibit 3-2, the yearly accrual costs by system were reduced by an equal percentage per year, using the following formula: Adjusted yearly accrual for outlier = Original yearly accrual*((system mean + 2*system standard deviation)/original twenty-year accrual).

Appendix D. Capital Cost Calculator for Energy and Water Improvements[13]

In contrast to many of the other measures discussed in this study, construction techniques and products that significantly improve the water- and energy-efficiency of the public housing stock do not fall squarely within existing definitions of modernization or accrual needs; these "green" measures were not previously considered necessary for making homes decent, safe, and affordable—or "marketable." However, efficiency technologies not only improve the basic living qualities of the housing units in various ways, but also reduce long-term utility costs in ways that offset their initial cost premium.

In response to this changing definition, we have developed a Capital Cost Calculator for Energy and Water Improvements (Calculator). This Calculator was designed to answer the following three questions:

- Which measures can be reasonably installed in public housing buildings to improve water- and energy-efficiency?
- How much will it cost to install these measures?
- How much will that cost be offset by energy and water savings—and hence, utility cost savings—so as to be cost-effective overall as determined by the HUD-accepted "moderate" simple payback within less than 12 years?
- How much will that cost be offset by energy and water savings—and hence, utility cost savings—so as to be cost-effective overall as determined by a more aggressive simple payback within less than 20 years?

In this calculator, "reasonable" measures include:

- More efficient alternatives for construction improvements that would already be performed as part of traditional modernization that are justified by the payback times (such as replacing heating or cooling equipment that has reached or surpassed its serviceable life with equipment that is even more efficient than current minimum industry standard);
- Efficient alternatives for early replacement of functioning systems that are justified by the payback times;

Measures in all buildings were evaluated for both the 12 year and 20 year payback criteria. Both sets of capital cost estimates include incremental costs for replacing equipment at the end of its useful life with higher efficiency alternatives and full costs for early retirement of functioning equipment, when

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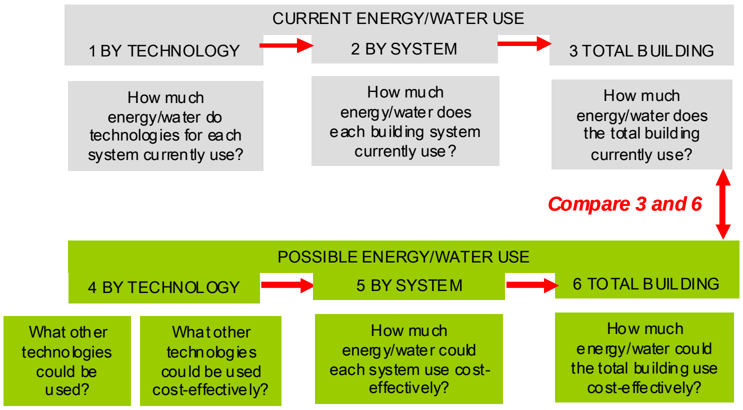
13 This Appendix was drafted by staff from Steven Winter Associates, with extensive input from Carlos Martin at Abt Associates.

deemed cost-effective. This decision was made within the calculator based on the determination of equipment remaining useful life from on-site inspections.

D.1. Overview of Tool Methodology

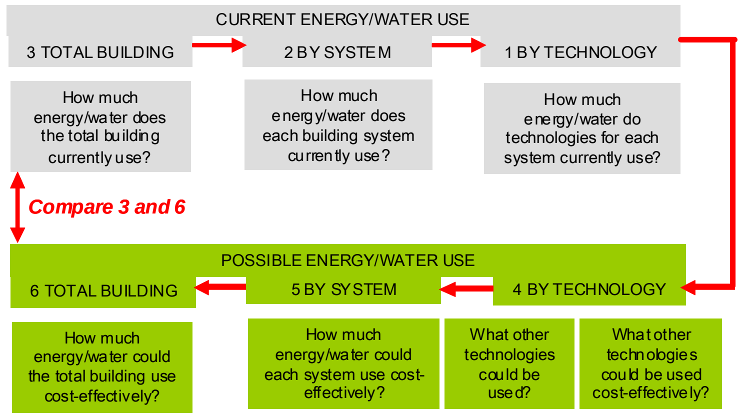
The calculator uses a combination of data sources and a unique logic model to compute the individual capital costs and utility savings per building. To do this, the calculator essentially compares "apples to apples"—in this case, "technologies to technologies." Existing technologies in public housing buildings must be compared to those technologies meeting current minimum industry standards or, when available, more significantly efficient technologies that may lead to dramatic energy (and cost) savings.

The traditional process for performing this calculation would be to: 1) document all of the existing technologies in a building (for example, in an energy audit); 2) measure their actual performance and utility costs; and then 3) calculate the total existing building energy and water use. Simultaneously, we would: 4) develop lists of alternative technologies to those currently in the building; 5) estimate their performance and cost (through modeling); and then 6) calculate the total possible energy and water use and savings. We can then compare the possible use ("6") to the existing use ("3") to determine savings.



However, an efficient method for calculating existing public housing's energy and water use (#3) has already been developed: a HUD-supported "benchmark" usage model allows a minimal amount of appropriate input data to predict that existing total for any given building.[14] This data comes from items already collected by the Abt team during on-site inspections as well as publicly-available climate data. So, additional site inspections for each building are not necessary and generally reliable estimates for all buildings can be calculated.

[14] D&R International, Ltd. (2007). "Benchmarking Utility Usage in Public Housing" Washington: U.S. Department of Housing and Urban Development, Office of Public and Indian Housing.



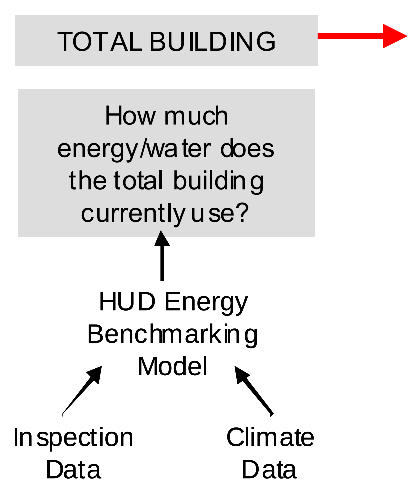
While calculating overall use more quickly, though, this added efficiency requires us to then drill down to the technologies in an alternative fashion. We first determine how much of the calculated total energy and water use comes from each different system within the building (like heating, cooling, water heating, lighting, and appliances for energy and showerheads, sinks, and toilets for water). We use a set of ratios for each system's use based on professional judgment and industry averages. This breaks down the energy usage into smaller and smaller components based on the inputs, until there is an energy load associated with a set of typical building technologies.
At that point, the calculator selects from a menu of available, efficient technologies for each system, calculates their energy/water and cost savings in the form of a simple payback (including whether the equipment is in need of replacement already), and includes only the most cost-effective improvements in the final capital costs calculation. That improvement cost, plus the estimated energy and water savings and their cost savings, are the final calculator outputs.

The following provides detailed descriptions of each step in this process along with critical assumptions.

Total Energy and Water Use in the Existing Building

The overall energy usage is pre-calibrated to an average HUD building based on the Public Housing Benchmarking model developed by ORNL and D&R International. With a high degree of certainty, the energy use of a specific building in the public housing stock can be calculated based on an equation that contains eight primary inputs:

- Total Heated Square Footage
- Number of Living Units
- Existence of a Central Laundry Facility
- Building Type (multifamily, etc.)
- Building Age
- Percentage of Total Space that is Shared Space
- Heating Degree Days

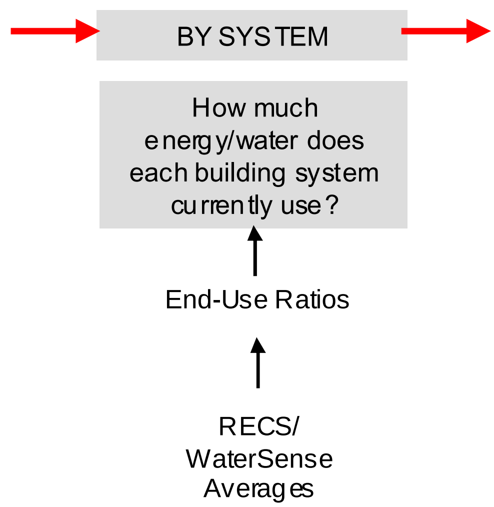


- Cooling Degree Days

The first six of these inputs are provided through on-site inspections in Abt Associates' Observable Systems Approach in the broader Capital Needs study. The last two are taken from the US Department of Energy (DOE) website's data regarding heating and cooling degree days for specific zip codes. The zip codes are taken from the on-site inspection records.[15] Estimated existing water use is not included in the benchmark calculations, and is determined for the same building based on the number of units in the building (also provided from inspection data) and average water use statistics from the Environmental Protection Agency (EPA).

System ("End-Use") Energy and Water Use in the Existing Building

After efficiently calculating the total building's energy and water use, the Calculator then uses ratios of "end-use" loads to break down the overall energy consumption into smaller consumption categories End-uses are defined as specific functions in a building, specifically: Heating, Cooling, Lighting, Hot Water, and Appliances. End-Use load ratios by housing type and climate zone was extracted from a straight average of housing data found in the DOE's 2005 Residential Energy Consumption Survey (RECS) that include all housing types without singling out public housing.[16] The data set is comprised of greater than 4,000 housing units in all regions of the country.

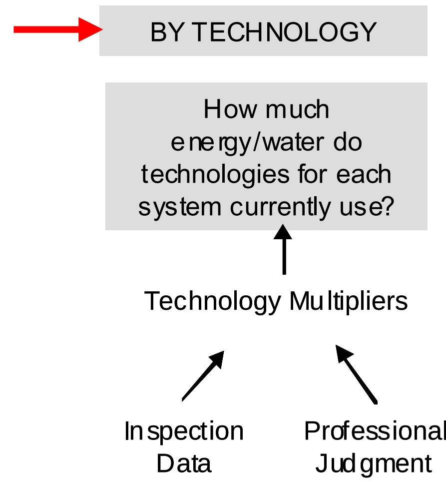


Three important additional assumptions were made to utilize these ratios. First, RECS data does not separate out lighting from the appliance load; because DOE's 2008 Building Energy Data Book states that 7% of the total energy consumption on average is lighting load, we were able to discount 7% of the total building energy use (as calculated in the previous calculation) and subtract it from the RECS appliance load directly. Second, water is not allocated based on end-load use because of differences in how water use is estimated nationally. So, the water breakdown skips this step and goes directly to technology-specific existing use. Lastly, it is important to note that, while the use of these ratios in similar calculations is common, the resulting loads are averages and may not representative unique conditions in specific buildings. This concern will be repeated when we calculate expected system water and energy use in the improved buildings (step "5").

15 http://doe2.com/Download/Weather/TMY3/.

16 For the purposes of this study, we can assume that the end-use loads are similar across housing types. Residential Energy Consumption Survey (RECS) 2005 raw data, by Energy Information Administration, a division of the United States Department of Energy.

Technology-Specific Energy and Water Use in the Existing Building



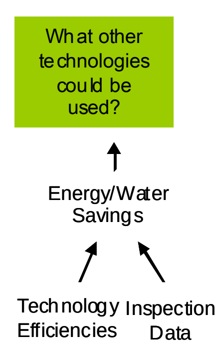
Finally, a combination of technologies and equipment combine to create the energy-use loads in the previous section. So, we need to then determine how much of the existing energy can be attributed to each specific technology. We do this through a serious of "technology multipliers" based primarily on professional judgment with regard to energy use and on EPA's WaterSense estimates for water use.

Technology multipliers are percentages that correspond to individual building components (like wall insulation load, window U-value load, etc.) associated with one end-use load. When the percentage impacts of all technology multipliers corresponding to one end-use load are summed together, the percentage impact equals one. For example, the total Heating end-use load is composed by:

- Basement Wall Insulation (12%)
- Wall Insulation (20%)
- Ceiling Insulation (15%)
- Window SHGC (5%)
- Window U-value (15%)
- Air-sealing (23%)
- Controls (10%)

The percentages in this example are not constant, as the assumed insulation levels, window insulation, climate zone, and building age (available through inspection data) affect these variables though their sum will always yield 100%. Descriptions of how these Technology Multipliers were derived and their values or ranges are provided in Sub-Appendix D-1.

Technology Alternatives: Efficiency Improvements and Cost Analysis



The selection of technology alternatives—that is, energy- and water-efficiency improvements—involves two steps. The first involves selection of technologically appropriate alternatives that increase efficiency from existing levels for specific existing technologies. For this, energy efficiency comparison numbers were created as a method to compare one technology of the same type against a more energy efficient technology. These comparisons are based on energy savings, which both assume certain unit configurations (window sizes) or use inspection data (number of light fixtures). The savings in turn are based on linear, proportional improvements from the assumed baseline. An example of this latter calculation is shown here:

- Ri = Assumed Current Wall Insulation = R-10
- Ru = Energy Efficient Upgrade of Wall Insulation = R-13
- X = Total Energy Consumption of End-Use-Load (Heating) = 5672 MMBTUs (Calculated from Linear regression equation * RECS %)
- Sub = Technology Multiplier for Exterior Walls = 0.1

$$Savings = Sub \times (X - (\frac{X \times Ri}{Ru}))$$

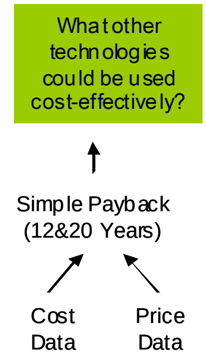
$$Savings = 0.1 \times (5672 - (\frac{5672 \times 10}{13}))$$

Savings = 131 MMBTU

Several assumptions were made in the development of this energy savings analysis. Items that do not directly consume energy but contribute to a building's energy-efficiency (like wall insulation and window solar heat gain coefficient) need special consideration. These technologies affect heating and cooling load but cost energy only when the heating and cooling equipment respond to the heat transfer. Therefore, the energy cost occurs at the HVAC system and *normally* requires that any energy savings be divided by the HVAC system efficiency to establish the amount of energy saved. But since the starting energy consumption output already includes the energy consumed by the heating and cooling system, the efficiencies of that equipment are already worked into the energy calculation. As a result, the energy savings of envelope characteristics (walls, windows, ceilings, floors, air leakage) did not need to be divided by the heating and cooling efficiencies. In contrast to focusing on how the envelope savings are calculated, the HVAC system savings is derived first by subtracting the envelope savings from the total energy consumption. Then, the HVAC system efficiency calculation can be applied to see if the technology is cost effective within the defined time frames.

An example of this is in order: the Calculator first determines that basement and wall insulation is cost effective and saves 500 MMBTUs in heating. When evaluating if the heating system upgrades are cost effective, that 500 MMBTUs is first subtracted from the existing heating amount of 1,500 MMBTUs (with 1,000 MMBTUs remaining). Then the assumed, existing 80% efficient furnace can be compared against a potential 90% efficient furnace as a matter of ratios. (1,000 * 0.80/0.90 = 888 MBTUS or 112 MMBTU savings). If this calculation was not done in this priority, then any HVAC savings would be overvalued when combined with envelope improvements. (1,500 MMBTU * 0.8/0.9 = 1,333 MMBTUs or 166 MMBTU savings). This 166 MMBTU is much more than 112 MMBTU savings that would occur when both envelope and HVAC energy efficiency measures are installed.

The second step involves a cost analysis to determine whether the alternative technology in question meets specific payback timeframes (12 and 20 years). That includes cost data for the technology improvements themselves (provided by the Abt Associates team member, AM Fogarty) as well as price data for energy and water. DOE's 2009 Energy Information Administration data are used to price electricity, gas, and oil (with regional fuel prices used where heating oil numbers are inconsistent), and water pricing data comes from an independent survey.[17]



To determine this, the need for replacement of specific systems (Heating Plant, Cooling Plant, Hot Water Plant, and Windows) because the equipment is at the end of its useful life needs to be addressed. Based on inspection data, this can be addressed by subtracting the cost of the minimum efficiency equipment from all equipment in that category before comparing to higher efficiency equipment. This leaves only the incremental cost of the upgrade.

For example, say that a furnace has a cracked heat exchanger and must be replaced because of carbon monoxide leaks. The assumed cost to replace the existing 80% efficient furnace with a new 80% efficient furnace is $2,300. A 90% efficient furnace costs $3,500, but because the furnace must be replaced the incremental cost included in the analysis is only $1,200. Additionally, the incremental energy savings are calculated between the minimum efficiency equipment and the high efficiency equipment. As a result, the simple payback is a calculation between the incremental costs and incremental savings.

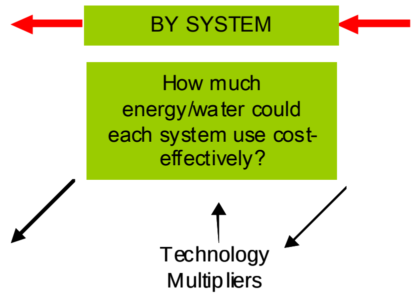
After the energy savings analysis and the cost analysis, an algorithm selects energy efficient measures based on the following criteria (in order of priority):

- Does the technology alternative meet simple payback requirements (that is, in 12-20 years)? If an alternative meets the shorter simple payback (12 years), it is not included in the longer simple payback listing (20 years) as well.
- Is the technology appropriate to the building type and current technologies installed?
  - For example, if a building uses a boiler, then air-source heat pumps or other unit-by-unit heating systems are not allowed to be returned.
  - Fuel switching is allowed between electric and gas heating sources.
  - Air-Source heat pumps are not allowed in climate zone 6 and higher.
  - Exit signs are not appropriate for single-family houses and townhouses.
  - Common Area Lighting is reserved for multifamily housing.
  - Pumps are inappropriate for single-family houses and townhouses.
- Does the technology save the most money of all technologies in the same category? For example, does a unit gas furnace with 95% efficiency save more money than an 8.2

[17] "2006 Water and Wastewater Rate Survey" by Raftelis Consulting.

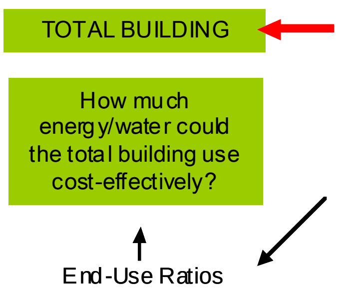
HSPF heat pump? Only one technology alternative, ultimately, is allowable in any given technology grouping though some upgraded options of these alternatives may be separately indicated—for example, R-30 ceiling insulation in the 12-year payback but R-60 in the 20-year. In this situation, the capital cost in the 20-year analysis will only be the additional cost difference between R-30 and R-60.

System Energy and Water Use in the Improved Building



The technology multipliers are utilized again to determine system-level totals of energy or water use and their consequent cost savings. The original end-use ratios are then used to calculate total system ("end-use") energy and water use and costs—and, hence, savings from the baseline.

Total Energy and Water Use in the Improved Building



The system (end-use) energy and water use and cost savings are simply added to determine the total building's energy- and water-use and total cost savings expected after the improvements from the 12-year and 20-year paybacks are made. In the case of the 20-year payback, the associated capital cost includes the sum of the 12-year payback measures plus any different 20-year payback measures (or the upgrade from the 12-year payback measures).

It should be noted, though, that the calculator does not currently include site-level energy and water use and cost calculations, nor does it further extrapolate onto entire public housing authority building stocks. The information for sample buildings is extrapolated to the property-level energy and water use and savings, PHA-level, and then to reflect the capital needs of the national stock following the same protocol for the modernization and accrual needs costs in the original study. Even when multiplied out for a whole site, though, it does not include site-level energy and water use outside of buildings (parking lighting, garden lighting, irrigation, etc.). These would have to be included to get a more accurate site-level estimate.

Discussion of Calculator Approach

As with any cost calculations based on assumptions and averages, there are numerous advantages and disadvantages to the Calculator. Among the list of advantages is the fact the core calculation for existing energy use (the benchmark model) is one that is already familiar to HUD and PIH. This calculation provides the additional benefit for this purpose of this study of providing a low-cost method to approximate energy costs for each building component and approximate energy savings from efficiency upgrades. With the limited energy and water information provided by the original site inspections, this modeling was especially helpful.

The primary disadvantage of this calculation approach stems from the need to drill down to technologies from that larger energy calculation. Various errors could arise both from the original energy use calculation as well as the two sets of end-use load ratios and multipliers that may not represent the actual buildings. In fact, the use of ratios and multipliers removed the possibility of incorporating component interdependence (that is, where one technology or end-use impacts the others, like heat from appliances or lighting adding to cooling loads).

Additional assumptions were also made about the technologies themselves; while some specific information can be gleaned from the inspection records about the kinds and quality of equipment and technologies in the existing buildings, some information about unit layouts had to be assumed. For example, heat pump hot water heaters can be larger than a standard hot water heater, and since mechanical room heights and clearances were not provided, the calculator may determine a heat pump hot water heater is cost effective, even though it may not fit into the space allotted. Similarly, because the heat pump hot water heater cannot fit in the space provided, the energy and monetary savings associated with that specific building may not be 100% accurate.

As the calculator is not capable of conducting whole building energy simulations equivalent to modeling software, there are limitations. Some, but not all, interactions between measures are accounted for. For example, the payback for a high-efficiency furnace in a unit that is poorly air-sealed will be different than the payback following air-sealing. Logic in the calculator accounts for this particular interaction, reducing the heating energy consumed based on improvements on air-sealing and then calculating the savings achieved with a high-efficiency furnace. However, the impact of reducing the lighting load on the heating load is not accounted for.

Since the goal of the calculator was an overall cost estimate for the population of buildings, it provides gross measures of costs and savings. The estimates were not based on energy audits (the preferred method), and simple payback analysis alone cannot indicate whether it is appropriate to expend funds on such improvements for a specific building. Before implementing any energy retrofits, it is important to conduct an audit of the specific property to develop the most appropriate package of retrofits for the individual location. A package of measures that is cost-effective for one building may not be for another, so it must be understood that positive payback does not necessarily translate into work that should be undertaken for any individual building. Similarly, measures should not be selected independently simply based on their payback, but according to an established hierarchy (ex. furnace replacements should not be selected without air-sealing and duct-sealing). Without actual utility data, the sensitivity of the capital cost estimate to the input parameters cannot be calculated.

In reality, a building manager and occupants can affect the actual energy performance several times over or under the average building consumption just by their behavior. Because of the aggregate nature of this information, the final calculations should not replace individual energy audits of buildings and sites that will likely reveal unique circumstances and needs. A typical energy audit provides information like: actual performance of heating, cooling, and hot water systems; square feet of window area; orientation of building; amount of insulation in walls, ceilings, and basements; light fixture count; light fixture wattage; and infiltration. None of these were included in the Calculator's input and could yield significantly different individual existing building use estimates and subsequent use and savings comparisons.

Summary

By using a combination of standard energy analysis techniques and assumptions of building characteristics, the Calculator is able to provide an estimated range of costs and energy savings for a larger number of buildings with a constrained data set.

Exhibit D-1 presents the cost drivers for the energy- and water-efficiency upgrade. It shows the ranking of the key contributors to the overall upgrade costs. Exhibit D-2 depicts the percentage of buildings that have each kind of upgrade.

Exhibit D-1. Cost Drivers for Energy- and Water-Efficiency Upgrade

	Technology Capital Cost as a Proportion of Overall Energy Upgrade Cost	Average Simple Payback (Years)
Wall Insulation	22.3%	9.5
Attic Insulation	13.2%	8.7
Furnace, Space Heating	10.9%	7.9
Airsealing Envelope	10.4%	8.2
E* Clotheswasher, Appliances	9.3%	4.0
Heat Pump, Space Heating	8.9%	9.8
DHW Heat Pump	5.4%	5.4
DHW Boilers	3.1%	8.2
Bsmt Insulation	3.0%	6.4
Aerosealing Ducts Fans	2.1%	5.7
1.28 gallons/flush Toilet	1.8%	2.9
Combination Boilers (Heating/ DHW)	1.7%	7.7
T5 Common Lighting	1.5%	2.2
Variable Speed Pumps	1.3%	5.8
Controls Commissioning	1.1%	4.0
1.5 gpm Shower	0.9%	0.1
Unit Lighting (CFLs)	0.8%	0.5
NEMA Premium Motors Pumps	0.8%	7.9
Windows	0.7%	5.1
ECM Motors Motor Fans	0.3%	2.7
0.5 gpm Lavatories Sinks	0.3%	0.6
Cooling Only Upgrade	0.1%	9.3
Photocell Common Lighting	0.1%	2.9
Occupancy Sensors Common Lighting	0.0%	1.1
LED Exit Signs, Common Lighting	0.0%	8.0

Exhibit D-2. Percent of Sample Buildings that Require Specific Energy- and Water-Efficiency Upgrade

	Weighted Number of Bldgs Needed Technology	Average Simple Payback (Years)
Unit Lighting (CFLs)	100.0%	0.5
1.5 gpm Shower	100.0%	0.1
0.5 gpm Lavatories Sinks	99.9%	0.6
Photocell Common Lighting	75.9%	2.9
Attic Insulation	60.8%	8.7
E* Clotheswasher, Appliances	57.8%	4.0
DHW Heat Pump	55.3%	5.4
1.28 gallons/flush Toilet	49.9%	2.9
Airsealing Envelope	42.0%	8.2
Windows	40.2%	5.1
Wall Insulation	39.5%	9.5
T5 Common Lighting	29.8%	2.2
Furnace, Space Heating	19.4%	7.9
Occupancy Sensors Common Lighting	17.8%	1.1
DHW Boilers	17.7%	8.2
Controls Commissioning	13.7%	4.0
Heat Pump, Space Heating	13.3%	9.8
ECM Motors Motor Fans	10.7%	2.7
Combination Boilers (Heating/ DHW)	10.5%	7.7
Variable Speed Pumps	8.7%	5.8
Bsmt Insulation	7.7%	6.4
Aerosealing Ducts Fans	6.3%	5.7
NEMA Premium Motors Pumps	3.1%	7.9
Cooling Only Upgrade	1.5%	9.3
LED Exit Signs, Common Lighting	0.1%	8.0

Sub-Appendix D-1: Technology Multiplier Values per End-Use Load

Heating

1. Ventilation Fans – 20% - Percentage derived using professional experience
2. Window SHGC – between 3% - 7%, climate zone depending. Percentage derived using professional experience
3. Controls – 10% Percentage derived using professional experience
4. Air-sealing – 23% Percentage derived using professional experience
5. Window Area – Percentage varies. Uses an elementary load calculation comprising of heating degree days, U-value, and area: (Area*U-value*HDD*24 = MMBTU). MMBTUs compared against load from Basement Wall Area, Wall Area, and Ceiling Area to generate a percentage of the total heating load.
6. Basement Wall Area – Percentage varies. Uses an elementary load calculation comprising of heating degree days, U-value, and area: (Area*U-value*HDD*24 = MMBTU). MMBTUs compared against load from Window Area, Wall Area, and Ceiling Area to generate a percentage of the total heating load. However, the ground has a more stable year-round temperature, and therefore is not subject to the complete Heating Degree Days as reported. An estimated factor of 3 was divided by the HDD representing one quarter of the air temp heating load.
7. Wall Area – Percentage varies. Uses an elementary load calculation comprising of heating degree days, U-value, and area: (Area*U-value*HDD*24 = MMBTU). MMBTUs compared against load from Basement Wall Area, Window Area, and Ceiling Area to generate a percentage of the total heating load.
8. Ceiling – Percentage varies. Uses an elementary load calculation comprising of heating degree days, U-value, and area: (Area*U-value*HDD*24 = MMBTU). MMBTUs compared against load from Basement Wall Area, Wall Area, and Ceiling Area to generate a percentage of the total heating load.

Cooling

1. Window SHGC – 3% - Percentage derived using professional experience.
2. Controls – 10% Percentage derived using professional experience.
3. Air-sealing – 23% Percentage derived using professional experience.
4. Window Area – Percentage varies. See explanation of calculation in heating section. Uses cooling degree days instead of heating degree days.
5. Basement Wall Area – elementary load calculation using cooling degree days, U-value, and area: (Area*U-value*CDD*24 = MMBTU). MMBTUs compared against load from Window Area, Wall Area, and Ceiling Area to generate a percentage of the total cooling load. However, the ground has a more stable year-round temperature, and therefore is not subject to the complete Cooling Degree Days as reported. Basement cooling load varies even less

than heating load as the temperature difference of the ground to air temperature is often smaller in the cooling season than in the heating season. Sometimes adding insulation to the basement decreases the cooling load. For these reason the cooling degree days were divided by 6.

6. Wall Area – Percentage varies. See explanation of calculation in heating section. Uses cooling degree days instead of heating degree days.
7. Ceiling – Percentage varies. See explanation of calculation in heating section. Uses cooling degree days instead of heating degree days.

Lighting

1. In-Unit Lighting – If housing type is a single family house, 92% of all lighting consumption happens in unit. If housing type is multi-family house, 58% of all lighting consumption happens in unit. Based on professional experience.
2. Common Area Lighting – If housing type is a single family house, 0% of all lighting consumption occurs in this category. If housing type is multi-family house, 36% of all lighting consumption happens in unit. Based on professional experience.
3. Exit Sign Lighting – Percentage equal to zero on single family and townhouses. Multifamily housing assumes 6 exit signs per floor with a total energy consumption equaling 1% of the lighting budget. Based on professional experience.
4. Photo sensor – 4% of the annual lighting budget (exterior lighting) is affected by the photo-sensor. Based on professional experience.
5. Occupancy Sensor – Professional experience. If housing type is a single family house, 1% of the lighting budget can be affected by an occupancy sensor. If the housing type is multi-family, then 4% of the lighting can be affected.

Appliances

1. Refrigerator – between 24% and 34% depending upon climate zone. Data derived from RECS data straight averages of all building types by climate zone.
2. Dishwasher – base percentage around 1%. Percentage derived from RECS data straight averages of all building types by climate zone. An additional 10% of the appliance load was added onto the dishwasher percentage if the housing type was Single Family or a Townhouse. This is to account for the reduced amount of energy a Single Family house uses for pumps and exhaust ventilation in comparison to a multifamily building.
3. Clothes washer – base percentage between 8% and 11%. RECS data straight averages of all building types by climate zone. Other components as part of this percentage include (Refrigerator, Dishwasher, Clothes washer, and Miscellaneous Appliances- Plug Load). 26.23% of the appliance load was added to the laundry when there is no common laundry. The percentage subtraction was based on Professional experience. An additional 5% was added onto the clothes washer percentage if the housing type was Single Family or a

Townhouse. This is to account for the reduced amount of energy a Single Family house uses for pumps and exhaust ventilation in comparison to a multifamily building.

4. Water Pumps – 0% allotted for single-family and townhouses, 10% for multifamily. Professional experience.
5. Flow – (water system performance) 0% allotted for single-family and townhouses, 10% for multifamily. Professional experience.
6. Miscellaneous Plug-in Load – Percentage varies between 11 and 47% depending upon all other appliance loads. Miscellaneous load percentage is the remainder of appliance percentages that equals one.

Hot Water

1. Showerhead Water Consumption – EPA's Watersense Calculator Assumptions. Assumed 80% hot water of total water volume for this fixture.
2. Lavatory Sink Water Consumption – EPA's Watersense Calculator Assumptions. Assumed 1% hot water of total water volume for this fixture.
3. Clothes washer Water Consumption – EPA's ENERGY STAR Clothes Washer Savings Calculator. Assumed 19% hot water of total water volume for this fixture.

Water

1. Toilet Water Consumption – Percentage varies depending on age of toilet and daily consumption of other water fixtures. EPA's Watersense Calculator Assumptions.
2. Showerhead Water Consumption – Percentage varies depending on age of showerhead and daily consumption of other water fixtures. EPA's Watersense Calculator Assumptions.
3. Dishwasher Water Consumption – Percentage varies depending on consumption of other water fixtures. Professional experience.
4. Clothes washer Water Consumption – Percentage varies depending on consumption of other water fixtures. Professional experience.
5. Lavatory Sink Water Consumption – EPA's Watersense Calculator Assumptions.

Appendix E. Comparison of the Inspection Process of REAC Versus the Capital Needs Assessment for the Key Drivers of Existing Capital Needs

The following is an analysis of the top eighteen cost drivers for existing modernization needs, comparing the REAC inspection process' evaluation of the system/component to that of the capital needs inspection process' evaluation of the same system/component.

1. **Windows** (BA) (*15% of Existing Modernization Needs)* The REAC inspection process accounts for broken, missing, or cracked window panes, damaged/missing window screens, damaged sills/frames/lintels/trim, missing/deteriorating caulking or sealant around windows, peeling paint, and security bars preventing egress. It evaluates the current observed conditions of the sampled windows (from the sampled buildings), and allows the inspector to score observed deficiencies as a Level 1, Level 2, or Level 3 deficiency. With the exception of the sills/frames/lintels/trim, most of these deficiencies are generally "maintenance related" repairs and would not be included in a capital needs estimate. The number of windows, their age, and their expected useful life are not captured as part of the REAC system, thus no estimate can be made of the costs to repair/replace the windows currently or as part of the accrual cycle.

   The capital needs inspection process for windows includes an evaluation of the overall age(s) of the windows, observed operation/glazing/hardware problems (energy efficiency/draftiness), type and material of the window(s), and a determination as to an "action level" for these windows based upon observed conditions. Multiple action levels could be recorded if different windows have different observed conditions, ages or materials. A count of the number of windows by type, and condition for each building was also procured during the inspection. Based upon the "action level" for the inspected windows, a cost code was then applied to each window line item to enable estimation of the overall cost of repairing/replacing windows and the annual expenses needed to keep windows in good repair.

2. **Kitchens** (DU) ***(13% of Existing Modernization Needs)*** The REAC inspection process accounts for missing/damaged cabinetry, missing/damaged countertops, inoperable dishwashers, inoperable garbage disposals, clogged kitchen drains, leaking faucets or pipes, missing/damaged sinks, excessive grease or inoperable range hoods/exhaust fans, missing/damaged/inoperable ranges/stoves, and missing/damaged/inoperable refrigerators. It evaluates the current observed conditions of these kitchen elements (from the sampled units), and allows the inspector to score observed deficiencies based upon the Level (1, 2, or 3) of action needed. "Numbers/counts" and "ages" of these elements are not accounted for as part of the REAC inspection process. The evaluations of the cabinetry/counters and appliances' does not include an estimate of remaining useful, but rather focuses more on routine,

maintenance related items, such as leaking faucets or clogged drains (which are not evaluated for the capital needs assessment).

The capital needs inspection process accounts for the cabinetry, countertops, and appliances associated with the four sampled units inspected. The age and condition of the cabinetry/counters and appliances were evaluated, and the actual numbers or counts of these items were also recorded. "Action levels" were determined based upon the criteria set forth in the inspection protocol, which included repair or replacement actions. Replacement actions may get triggered if a component has exceeded its expected useful life, or if that component is beyond repair. The "action levels" accounted for current conditions and overall operation. Note that maintenance related items such as "a clogged drain" were generally considered to be handled as an immediate repair by site staff, and no capital costs would be applied.

3. **Bathrooms (DU)** ***(10% of Existing Modernization Needs)*** As in the kitchens, the REAC inspection process accounts for damaged/missing bathroom cabinets (vanities and medicine cabinets), damaged/missing sinks, clogged drains, leaking faucets/pipes, damaged/missing showers/tubs, inoperable ventilation/exhaust systems, and damaged/clogged/missing toilets. It evaluates the current observed conditions of these bathroom fixtures and accessories (from the sampled units) and allows the inspector to score observed deficiencies based upon the Level (1, 2, or 3) of action needed. "Numbers/counts" and "ages" of these elements are not accounted for as part of the REAC inspection process. Evaluations of the bathroom fixtures and accessories based on remaining useful life are not part of the assessment process. However, routine maintenance related items, such as leaking faucets or clogged drains, are evaluated as part of the assessment.

   The capital needs inspection process accounts for the vanities and medicine cabinets, inset (in vanities) or wall hung sinks, tubs/showers and surrounds, ventilation/exhaust systems, and toilets. Wall hung accessories were also evaluated as part of the bathroom inspections. "Action Levels" were determined based upon the criteria set forth in the inspection protocol, which included repair or replacement actions. Replacement actions may get triggered if a component has exceeded its expected useful life, or if that component is beyond repair. The "action levels" accounted for current conditions and overall operation. Note that maintenance related items such as leaking plumbing or a running toilet were generally considered to be handled as an immediate repair by site staff, and no capital costs would be applied.

4. **Exterior Walls (BA)** ***(4% of Existing Modernization Needs)*** The REAC inspection process evaluates cracks, gaps, missing pieces, holes, and spalling of wall surfaces (usually masonry). It also evaluates missing/damaged caulking or mortar joints and stained or peeling painted materials. The deficiencies (1, 2, or 3) dictate the extent of the repair and/or replacement of the system/material. Note that the REAC inspection process does not account for square footage or lineal footage of siding or trim elements. Deficiencies are based upon percentages, fractional measurements, or sections of material needing to be addressed.

   The capital needs inspection process evaluates the type and overall square footage/lineal footage of the exterior wall materials, accounting for age and conditions. Repair/replacement actions are based upon the conditions observed in the field, or based upon the expected useful life of the particular material. A percentage of the material to be repaired/replaced was also noted.

5. **Roof Coverings** **(BA)** ***(4% of Existing Modernization Needs)*** The REAC inspection process considers the following roof related items: damaged/clogged drains, damaged soffits or fascia materials, damaged vents, damaged/torn roofing membrane, missing ballast, ponding missing/damaged gutter and downspout components, and missing/damaged roofing shingles. It evaluates the current observed conditions of these roofing components (from the sampled buildings) and requires the inspector to score any observed deficiencies based upon levels of action (1, 2, 3). Overall square footage of the roofing materials, counts of interior roof drains, and lineal footage of gutters/downspouts are not accounted for as part of the REAC inspection process. Evaluations of the roofing materials, based upon remaining useful life, are not part of the assessment process, as immediate conditions generally dictate action levels.

   The capital needs inspection process is much more comprehensive, accounting for the roofing structure, roof coverings, interior and exterior drainage, chimneys, hatches, skylights, penthouses, and parapet walls. "Action Levels" were determined based upon the criteria set forth in the inspection protocol, which included repair or replacement actions. Replacement actions may have been triggered if a component has exceeded its expected useful life, or if the component is beyond repair. Maintenance related items, such as the redistribution of roofing ballast, are generally considered to be handled as immediate repair issues for site staff to address, and no capital costs would be applied. The capital needs inspection process includes acquiring total square footages for roofing materials, counts of internal drains, hatches, skylights, chimneys, penthouses, and lineal footage of parapet walls and exterior roof drain systems.

6. **Water Mains** **(SS)** ***(3% of Existing Modernization Needs)*** The REAC inspection process only evaluates water supply within any area of the building(s). It does not address underground water main lines that supply water to the building(s). The REAC inspection process would have to be modified to account for site related water main line evaluations.

   The capital needs inspection process evaluates the "size," "type," "age," and "lineal footage" of the site water mains (if they existed and the property was responsible for their maintenance/replacement). Though most water main lines are underground (no subsurface excavation was performed), their overall age and repair history (information retrieved from site representatives) dictates a possible repair/replacement action.

7. **Interior Doors** **(DU)** ***(3% of Existing Modernization Needs)*** The REAC inspection process evaluates unit interior doors for surface conditions, frame damage (affecting locking mechanisms), and damaged hardware and locks. Most deficiencies are scored as Level 2 or 3 deficiencies. These would require repair or replacement of the components.

   The capital needs inspection process evaluates the "number/count," "age," and "conditions" of the doors. Locking mechanism and hardware repairs are generally considered maintenance concerns. Door and frame conditions dictated the repair/replacement actions. These actions are recorded accordingly on the DU inspection books, with appropriate coding for each line item.

8. **<u>Hot and Cold Water Distribution</u> (BME)** ***(3% of Existing Modernization Needs)*** The REAC inspection process evaluates leaks of the central water supplies and leaks associated with pumps and valves. It also evaluates whether a water supply is available to the inspected building. Deficiencies associated with these systems are considered "Level 3" scores, and may trigger "Health and Safety" deficiencies. Most of these "leak" concerns are typically addressed as maintenance issues.

   The capital needs inspection process evaluates whether repairs associated with distribution piping requires a minor repair action (usually a maintenance/operating expense) or replacement of the system. The overall gross square footage of the area (within the building inspected) is calculated, and the percentage of system replacement is also noted. Associated pumps and valves were evaluated for leaks and for overall age and condition. Replacement actions for piping, pumps, and valves may have been triggered if the systems had exceeded their expected useful lives, or if the component is beyond repair. Cost codes are then applied to the line items (in the MR and BME inspection books).

9. **<u>Sidewalks</u> (SS)** ***(2% of Existing Modernization Needs)*** The REAC inspection process evaluates broken/missing hand railings, cracking/settlement/heaving walkway surfaces, and spalling of concrete or masonry surfaces. Deficiencies (1, 2, or 3) are based upon conditions observed in the field. Walkway surface conditions are graded based upon "percentages" of area affected or if cracks exceed ¾" in size. The REAC inspector does record walkway square footage (combined with parking square footage) as part of the inspection process.

   The capital needs inspection process evaluates the "age," "type," "condition," and overall "square footage" of the site walkways. "Action levels" for repair or replacement of sidewalk surfaces were based upon observed condition in the field. The inspector recorded the action level, percentage of area affected, and the appropriate cost code.

10. **<u>Closet Doors</u> (DU)** ***(2% of Existing Modernization Needs)*** The REAC inspection process evaluates unit closet doors for surface conditions, frame damage (affecting locking mechanisms), and damaged hardware and locks. Most deficiencies are scored as Level 2 or 3 infractions. These actions would require repair or replacement of the components.

    The capital needs inspection process evaluates the "number/count," age, and conditions of the doors. Locking mechanism and hardware repairs are generally considered maintenance concerns. Door and frame conditions dictated the repair/replacement actions. These actions are recorded accordingly on the DU inspection books, with appropriate coding for each line item.

11. **<u>Fencing</u> (SS)** ***(2% of Existing Modernization Needs)*** The REAC inspection process evaluates damaged/falling/leaning fencing or gates, holes in fencing, and missing sections. It

does not account for the "age," "type," "height," or the lineal footage of the fencing. Deficiencies (1, 2, or 3) dictate the overall scoring.

The capital needs inspection process evaluates the size/height, type, age, and lineal footage of the site fencing. Repair or replacement actions are dictated based upon observed conditions in the field.

12. **Exterior Unit Doors** **(BA)** ***(2% of Existing Modernization Needs)*** The REAC inspection process evaluates unit exterior doors for surface conditions, frame damage (affecting locking mechanisms), and damaged hardware and locks. Most deficiencies are scored as Level 2 or 3 infractions. These actions would require repair or replacement of the components.

    The HNCPS inspection process evaluates the "number/count," "age," and "conditions" of the doors. Locking mechanism and hardware repairs are generally considered maintenance concerns and not recorded as part of a capital needs inspection. Door and frame conditions dictated the repair/replacement actions. These actions are recorded accordingly on the DU inspection books, with appropriate coding for each line item.

13. **Exterior Lighting** **(BA)** ***(2% of Existing Modernization Needs)*** The REAC inspection process evaluates exterior lighting fixtures as to whether they are damaged/broken/missing or whether bulbs associated with the fixtures are damaged/broken/missing. The "Level 2 or 3" deficiencies are based upon percentages (20% to 50% +) of fixtures affected. Level 3 infractions may trigger a "Health and Safety Hazards: Electrical Hazards" notation as well. Bulb replacement for lighting fixtures is generally considered a maintenance concern.

    The capital needs inspection process evaluates the "number/count," "age," "condition," and "remaining/expected useful life" of the building(s)' exterior lighting fixtures (incandescent, fluorescent, etc.) and high intensity lighting fixtures (high pressure sodium, etc.). Fixtures are evaluated as to whether they needed replacement (due to being damaged, missing, etc.), and counts were entered accordingly on the BA inspection books. Bulb related problems would warrant replacement as a maintenance concern, and not be considered a capital expenditure.

14. **Living Room Floors** **(DU)** ***(1% of Existing Modernization Needs)*** The REAC inspection process evaluates living room flooring for the following conditions: bulging/buckling, damage, missing flooring/tiles, peeling finish, rot/deteriorating subflooring, and water stains/water damage/mold/mildew. Deficiencies (1, 2, or 3) for these conditions are based on percentages of flooring affected (5% - 50% +) or on overall square footage of flooring affected (1' to 4' + square feet). Rotting/deteriorating subflooring may require inspection by a structural engineer. Water damaged or mold/mildew affected flooring may trigger a "Health and Safety: Air Quality" notation. Overall square footages of unit living area flooring are not obtained as part of the REAC inspection process.

    The capital needs inspection process evaluates the "types of flooring materials," "age," and "condition." Dependent upon "age" and "conditions" observed in the field, action levels and associated cost coding were noted. Overall square footages of unit living areas were obtained as part of the inspection process as well. This is integral in forecasting replacement cycles for unit living area flooring in future years.

15. **Gas Mains** (SS) ***(1% of Existing Modernization Needs)*** The REAC inspection process does not evaluate natural gas lines, with respect to underground utility lines. These lines would routinely be the responsibility of the utility company. The REAC inspection process would have to be modified to evaluate any non-utility-owned natural gas lines that may be running throughout the site.

    The capital needs inspection process evaluates the "size," "type," "age," and "lineal footage" of the site's natural gas lines (if they existed and the property was responsible for their maintenance/replacement—not if they were the utility company's responsibility). Though most natural gas lines were underground (no subsurface excavation was performed), their overall age and repair history (information retrieved from site representatives) dictated a possible repair/replacement action.

16. **Cold Water Lines** (SS) ***(1% of Existing Modernization Needs)*** The REAC inspection process only evaluates water lines within any area of the building(s). It does not address underground cold water lines that supply water to the building(s). The REAC inspection process would have to be modified to account for site related cold water line evaluations.

    The capital needs inspection process evaluates the "size," "type," "age," and "lineal footage" of the site cold water lines (if they exist and the property is responsible for their maintenance/replacement) . Though most cold water lines are underground (no subsurface excavation was performed), their overall age and repair history (information retrieved from site representatives) dictates a possible repair/replacement action.

17. **Temperature Controls** (DU) ***(1% of Existing Modernization Needs)*** The REAC inspection process does not specifically evaluate temperature control devices within an apartment. The REAC inspection protocol does evaluate whether an HVAC system is operable, and it does evaluate whether an "electrical outlet or switch" is missing. Hence, this inspection process does not evaluate the "number/count," "age," or "condition" of the temperature controls within the apartment(s).

    The capital needs inspection process evaluates the "number/count," "age," and "condition" of the unit temperature controls. Dependent upon age and condition of these devices in the field, action levels were dictated accordingly.

18. **Domestic Hot Water (DHW) Heaters** (DU) ***(1% of Existing Modernization Needs)*** The REAC inspection process evaluates domestic hot water generation equipment and associated peripheral equipment for the following: misaligned chimney/ventilation system, inoperable unit/components, leaking valves/tanks/pipes, pressure relief valve missing, and rust/corrosion. Most deficiencies are "Level 3" infractions, some of which may trigger a "Health and Safety" notation. Results from these evaluations will dictate repair/replacement actions for the equipment. Note that the REAC inspection process does not take into account the "type/fuel," "number/count," or "age" of the DHW equipment.

The capital needs inspection process evaluates the “number/count,” “age,” and “type/fuel” of the DHW equipment serving the apartment. Conditions observed in the field dictated action levels and cost coding for the equipment. Remaining and expected useful life cycles for this equipment may have dictated action levels as well.